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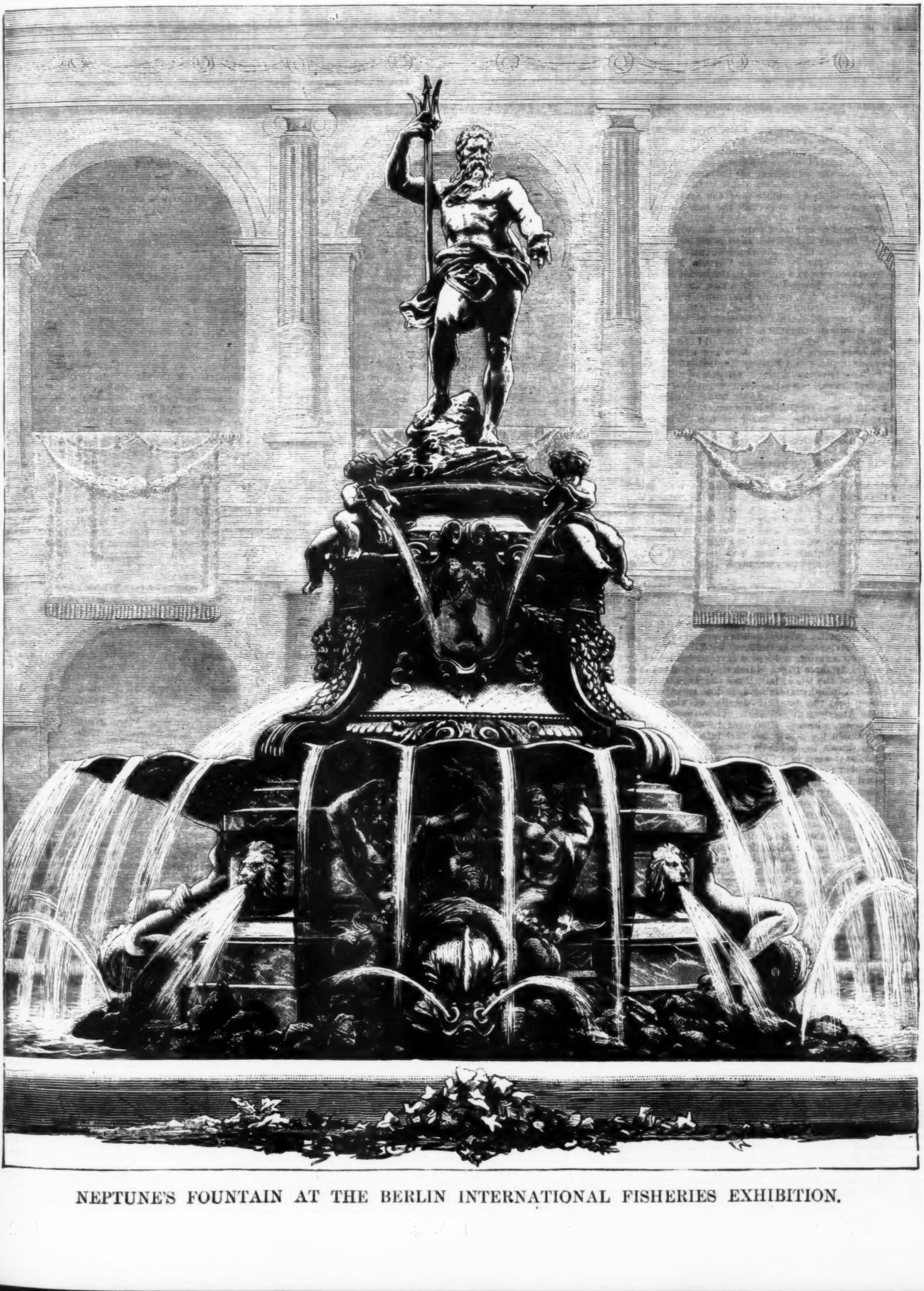


NEPTUNE'S FOUNTAIN AT THE BERLIN INTERNATIONAL FISHERIES EXHIBITION.

THE BERLIN INTERNATIONAL FISHERIES EXHIBITION.

As we have mentioned in a former number, art has by no means been neglected at the Berlin International Fisheries Exhibition, and the Neptune's Fountain in the court of the Agricultural Museum, which is represented on our first page, for which we are indebted to the *Leipziger Illustrirte Zeitung*, gives proof to our assertion.

The fountain was constructed of cement stucco in Renaissance style, according to the designs of the sculptor, Eberlein, and the architect, Heyden. It is about 39 feet high, and its plan is an oblong rectangle. At the base of each of the larger sides two long-haired wild Tritons, whose fish bodies encircle a dolphin in elegantly curved lines, support an enormous shell, the surface of which is waved so as to resemble the ocean waves, and to form depressions in the edge to permit the water to flow from the shell. On the smaller sides, handsome Nereids, resting upon dolphins and having nets spread upon their laps, also support large shells, and form a most elegant artistic contrast to the grim and wild Tritons.

Above the four shells the tapering middle part of the pedestal rises, provided with the coat of arms of the city of Berlin on the wide sides, and with satyr masks on the smaller sides, the curved edges being surmounted with rich gilded festoons. Four jolly little urchins sit upon the base at the feet of the monarch of the sea, and blow in the oddest of all fish trumpets, the Triton's horn, but in place of the round waves that should issue from the instruments we see two crossing jets of water, which drop into the shells supported by the Tritons.

The excellent figure of Neptune rests upon the elegant pedestal. The weight of the body rests mainly upon the left leg, and his right hand grasps the symbolic representation of his power, the trident, whereas he welcomes visitors with his left hand into the exhibition of the treasures of his domain.

As the above-described fountain is of the greatest artistic value, it has been proposed to execute the same in metal or stone.

Perhaps that which will most surprise the visitor to the International Fishery Exhibition, says a correspondent of the N. Y. *Tribune*, will be the comprehensive definition given to the word "fishery" by the German Fishery Society, under whose auspices the fair in the Invaliden Strasse has been organized. Instead of only a monotonous mass of stuffed and preserved fish, muddy aquariums, and the like, one finds in this new building, destined to be the Agricultural Museum, a vast and varied collection of objects, both animate and inanimate, organic and inorganic, natural and artificial, all more or less intimately related to the piscatory science. In some cases, however, there are exhibits which look rather out of place in a Fishery Exposition. A Berlin firm, for instance, displays a large number of nautical instruments, and several countries have encroached upon the department of ornithology, the excuse being that the collections which they send represent birds which either feed on fish or serve as bait for the catching of fish. The cormorants, second only to old Izaak Walton in their angling skill, may be excepted from this criticism, and richly deserve the place accorded them in the American, but more especially in the Chinese department. But what has Captain Boyton's India-rubber suit to do with fish, unless sent over as our best specimen of American fish stories? A captious critic might say that the shrewd New Englander who, pointing triumphantly to a broad band of leather which, cut in twain, has been so firmly united again that it supports a heavy mass of iron, asks you to buy a bottle of his "fish glue," has about as much right here as the score of Berlin jewelers who are selling necklaces, cuff buttons, breastpins, etc., because they are manufactured from coral, pearl, or sea shells.

AMERICA'S GREAT DISPLAY.

But let us glance for a moment at some of the real piscatory exhibits of the American department. And in the very beginning let me say that as regards extent, value, and usefulness, the United States collection shows second to none, and in many cases surpasses even Germany herself. The special catalogue of our exhibit, a large octavo pamphlet of two hundred and sixty-three pages, which equals in size the official catalogue of the whole fair, is not the least creditable feature of our display, containing as it does an explanation, often running into the smallest details, of almost every article in the American department. Then there is a model of the purse seine, which is often over 1,300 feet in length, and reaches down for nearly 204 feet into the ocean, and which, when drawn in, holds five or six hundred mackerel, caught, as it were, in an immense old-fashioned purse; a fine model of a menhaden guano manufactory, where the oil is pressed from the fish and the residue converted into manure, an industry limited almost wholly to New England, and increasing very rapidly in importance; Professor Ward's collection of casts, many of which have been purchased by the Vienna Zoological Museum; and a valuable series of models of fish-breeding devices. The American exhibit is very rich in piscicultural apparatus. The first hatching-box used in the United States, invented in 1851 by our earliest fish culturist, Dr. Garlick, is pointed out as an object of historical value. But perhaps the most interesting and unique exhibit in this branch of the science is the large model of the National Fish Commission's steamer Fish Hawk, a sea-going vessel of 458 tons, which is nothing more nor less than a great ocean hatching-house. We have a large display of fishing boats of all sizes and descriptions, from the Colvin portable canvas boat, which can be packed away in a space 24 inches long, 6 inches wide, and 3 inches thick, and can yet carry six men, up to the fully-equipped whale boat, which stands in one of the annexes, flanked on either side by a stuffed Swedish whale. Perhaps the prettiest and trimmest of these fishing boats is the Shadow Canoe, built in Brooklyn and bought by some admiring European for $125. Hard by, a large Indian bark canoe, with two Indians standing erect in it, with paddles in their hands, attracts much attention. Six full-sized and full-rigged dories are scattered about in different parts of the Exposition.

Some of these models have an interesting history. There is, for instance, in the Holland department, a two-masted schooner now extensively used in the Dutch herring fisheries. It is a very fast sailer, and the foremast lets down and rests in a crotch when the nets are out. This vessel was introduced from France in 1867, and supplanted the buigne, a clumsy, sluggish sort of boat, very typical of the Dutch temperament, which was often two or three weeks returning home from the fishing banks. The French vessel can make the voyage in as many days, and, as a consequence, the fishermen of Holland find that the herring fisheries, which were up to this time rapidly on the decline, are now remunerative.

In one of the rooms of the American department is an immense leather-back turtle fastened high up on the wall. When the Emperor and Empress visited the Exposition, the former, who was astounded at the size of the reptile, waited until the Empress, who was on Mr. Mather's arm, came up, and then the aged Kaiser pointed out his discovery with the ecstasy of a boy. Perhaps this common turtle left a deeper impression on the royal mind than all Professor Goode's wonderful maps, showing the geographical distribution of fishes, or Mr. Mather's valuable inventions in pisciculture.

The remarkable completeness of the American exhibit is perhaps best shown in the space given up to angling apparatus. While the English exhibit in this department is limited to two cases, a whole room is scarcely large enough to hold what we have to present. It is about perfect. There are tiny nickel-plated reels for use among our inland brooks and lakes, and thence they run all the way up to the large iron black-painted reels used on the sea for halibut fishing. Here we see specimens of the primitive Indian fish lines, made of seaweed, strips of hide, etc.; there the delicate, strong lines of braided silk. In another case are displayed side by side with the great clumsy wooden hooks of the aborigines, ornamented with a carved point, which reminds one of the figure-head of a ship, graceful little steel hooks, with highly polished mother-of-pearl flies, and immense strong shark hooks, looking like anchors. In this same room is a Brand's bomb-lance, for use in the whale fishery, which, shot into the whale's body, explodes there.

EXHIBITS OF OTHER COUNTRIES.

I shall say only a word about the exhibits of some of the other countries. The English department, which occupies a few hundred square feet near the American, is, after the Russian, perhaps the poorest in the palace, falling far short of the real importance of Great Britain's fisheries. In the Norwegian department I noticed a most beautiful robe made of eider-down. Denmark offers some fine scale work, in the form of baskets, mats, etc., while her dependencies are well represented, Greenland by an immense Polar bear, and the Faroe Islands and Iceland by seal skins. Germany is remarkable for her rich displays of pearls, corals, etc. Italy presents a good collection of alcoholic specimens of fish, and perhaps the best series of wax models, showing the anatomy of fishes, to be seen in the whole Exposition. Holland leads in her display of nets, and is also rich in models of boats. The most characteristic of the latter is the bomb boat, as it is called, a logy, tub-shaped apology for a boat, which is launched from the beach by horses and fishermen after great labor and loss of time. The Chinese exhibit is the oddest in the Fair. Pictures, defective as usual in perspective, adorn the walls and represent most astounding angling scenes and feats. Hideous figures of fishermen and fisherwomen, dressed in the rough clothing of their humble calling, and set up stiffly in corners here and there, form rather a repulsive feature of the Celestial department. The Japanese, notwithstanding their great antipathy to everything Chinese, present the same general appearance in their department as is seen in the latter. Here two pictorial drawings are hung upon the walls and over the windows. Gorgeously-dressed women are represented riding sea monsters, or catching fish in small nets, the fish in every case swimming toward and never away from their destruction. Japan alone exhibits a devilfish, and near by are to be seen great crabs, one of them stretching out his arms for nine feet. Russia's display is chillingly meager, the best thing being a large model of a sturgeon, showing how caviare is obtained. A certain Joh Seebeck exhibits as a Russian invention a fish-freezer, which, I am assured, was originated in America, carried to Russia, and is now sent forth as a Russian contribution to the Exposition.

PREPARED SEA FOOD AND FRESH FISH.

One part of the fair—an annex—is wholly devoted to the various kinds of food that the seas furnish to man. Norway, for instance, sends a sort of fish meal from which a fish pudding is made, and also a lot of fresh dried cod put up in small bales fastened with wire thongs like hay. Sweden, among many other things, is represented by a mass of dried skates, a fish, as I was informed by an old fisherman at my elbow, that is never used in America as an article of food. Our own exhibit in this department is unquestionably the best, but I shall make no attempt to enumerate the articles.

Large open refrigerators or tables covered with finely chopped ice exposed to view fresh fish of all varieties. The agents of the different countries receive daily invoices of fresh fish, which are laid almost alive on these banks of ice. Though separated from our own country by over 3,000 miles of ocean, we are not behind other nations in this respect. Mr. E. G. Blackford, of Fulton Market, has kept American fishes before the European public in a very creditable way. The day I visited the Exposition I was much amused at seeing a dozen large American oysters almost lost on one of these large ice fields. An invoice of live frogs arrived this same day, and was placed in one of the aquariums of the grotto.

But it is not only in our *materiel* that America stands first in this Exposition; in *personnel* also she leads. The United States almost alone of all the countries has on the spot practical as well as theoretical men who can explain intelligently the advantages and uses of all the exhibits. Professor G. Brown Goode, in charge of the exhibit, though a rather young man, is thoroughly acquainted with the scientific side of the fisheries. Captain J. W. Collins, one of those plain, honest, practical Americans who care more for facts than theories, has the supervision of the deep sea fishery division. He has been a fisherman since his youth, and understands the handling of a smack as well as a net. Mr. Frederick Mather, sometime editor of the fish culture department of the Chicago *Field*, who has made three previous voyages to Europe in the fishery interests, has charge of the piscicultural part of the exhibit. Great regret is expressed by fish culturists in Europe that Professor Baird was not able to come over. I was told that Herr von Behr, President of the German Fishery Society, while examining the American department, actually uncovered his head when Professor Baird's name was mentioned, saying that too much honor could not be paid to this distinguished American, who had three times stocked the rivers of Germany with salmon.

It is sometimes doubted that international exhibitions are of benefit to the world. Let me cite a few examples to prove that they are a benefit. A certain gentleman, much interested in the fisheries, came all the way from Norway to study the models of fishing boats exhibited at this Exposition. He examined the boats of the American department with great care and surprise, and departed with much new and valuable information. Another gentleman, who has been governor of the Dutch East India possessions, was sent to Berlin by his government to select improved fishing boats for the East Indies. He fancied the American dories, and they will probably be henceforth used in the Dutch possessions. In the Norwegian department is the gillnet, which, Captain Collins informed me, could be used advantageously in the United States, for with it cod can be taken without bait, a practice not known in our cod fisheries. About two years ago Professor Baird, while dredging off the Massachusetts coast, discovered the pole flounder, a fish until then quite unknown. The Professor sent some of these fish to prominent New York hotels and caterers, who pronounced them very good eating. This fish, like the sole, has a very small mouth and cannot be caught by a hook. One of our representatives, therefore, has been directed to make a study of drag nets, a sort of net very much used in the Old World, and many models of which—as, for example, the beam trawl net—are to be seen here. He intends to visit England for the purpose of seeing drag nets in actual operation, and hopes to take back with him a knowledge of these nets that will enable our fishermen to employ them in catching the pole flounder, and thus add a new source of profit to our fish industry.

THE AMERICAN FLOUR TRADE.

THE production of wheat flour, like many other industries, has of late years grown enormously throughout America. Advantage has been widely taken of the great and extensively distributed water power. Numerous mills have been erected and fitted up with the most modern and effective machinery. Besides fully providing for the growing wants of a population of forty-five millions, the exports have been expanding largely. Last year the flour exports of the United States to Great Britain alone reached 6,863,172 cwt., they are double those of 1878, they are four times those of 1877. This is exclusive of the 460,435 cwt. forwarded from British North America, which has nearly doubled her exports since 1877. The wheat for grinding is carefully selected and cheaply handled; railroads, canals, or rivers bring it into the mill and take away the flour; on through bills of lading it is cheaply forwarded to European ports; special agents distribute it throughout this country; and American millers declare that this important industry can be still further developed, and that flour can be made in America and forwarded and sold in Great Britain cheaper than it can be made there. Although this latter proposition is untenable, there is no doubt that the production of flour throughout the world has been improved and cheapened by American invention and skill, while the large surplus supplies both of the States and of Canada notably reduce prices and narrow the profits of British millers. Owing to shortened consignments from Hungary and Austria, many American mills in the spring wheat States have for two years been turning out large proportions of the highly albuminoid patent flour.

The headquarters of the manufacture of American patent flour is Minneapolis, the twin capital of the fertile State of Minnesota, where the mighty stream of the Mississippi pours over a precipice fifty feet high. On either side of the river the flood has been deflected into tunnels of stone and concrete, drives turbine wheels which move saw mills and turns out annually 150 to 200 million feet of sawn timber, distributes hundreds of miles to build settlers' houses, and supplies the wants of States less bountifully provided with timber. Still more widely distributed is the flour ground by twenty-five mills, varying from three to eight stories high; their floors computed to occupy an area of one and a quarter million feet, and filled with superior modern machinery. This milling enterprise has grown rapidly. In 1873 there were but twelve mills, not worth more than $50,000 each; now there are twenty-five valued at a low estimate at $75,000. Four have been built during 1879. Largest of all is one in course of construction by ex-Governor Washburn, which will have a daily producing capacity of 3,000 barrels. The Washburn B mill has recently been completed and fitted up with thirty run of stones, forty sets of rollers, and superior machinery and appliances at a cost of $350,000. With the Washburn C mill it has a daily producing capacity of 2,000 barrels of flour. Among the other big concerns are the Crown Roller Mill, belonging to Messrs. Christian Brothers & Co., with a daily output of 2,400 barrels; and the several well arranged mills of Messrs. C. A. Pillsbury & Co., who turn out 1,800 barrels a day, and whose brand secures the highest market quotations on either side the Atlantic. In 1860 Minneapolis turned out annually 30,000 barrels of flour. Her present producing powers would almost enable her to do this in two days. With a little extra effort she could nearly manage to furnish the 12,000 sacks (of 280 lb.), which are said to be consumed daily in London. Her actual daily turn out when all the mills are working is 12,000 barrels. She ground in 1879 upwards of one and one-half million barrels, and of this large produce nearly one-third (442,598 barrels) was exported. The only other place where anything approaching to this business is overtaken is St. Louis, where the flour produce of 1879 was upwards of 2,000,000 barrels.

To make the best of the ceaseless motive power and maintain it in its present position, it was requisite to prevent the wearing away of the soft rock over which the mighty tide of the Mississippi pours. Observation shows that the falls were once several hundred feet lower down, were slowly being moved back, and to obviate this inconvenience, with the help of a United States Government appropriation, a substantial wall, four feet thick, has been built against the falls, sloping off about seventy feet, and over this is riveted an apron of stout planks. For the water privilege the mill pays $1,260 for every nine run of stones, but some of the older concerns have more favorable terms. Many large, well-situated English steam mills do not pay much more for their motive power. Coal at 6s. to 7s. per ton are estimated to put 2s. on each quarter of wheat ground. Alike in a well-placed English, as in a similarly favorably circumstanced American mill, the total expenses for rent, interest on capital, water or steam power, amount to about 2s. on each barrel of flour (196 lb.)

The Minneapolis millers have formed an association through which all purchases of wheat are made, which employs agents in various parts of the country, and distribute the supplies as required to the different mills in proportion to their run of stones or rollers. Settlements are made once a week. Every mill is provided with its elevators, so that the cars, containing 400 bushels, all loose, are brought up, unloaded, and are ready for dispatch in fifteen minutes. The grain is usually winnowed several times, run through a smut machine, passed down a shute, in which powerful magnets retain any portions of wire, nails, or other metal, which, besides injuring the stones and rollers, are also a fertile cause of explosions, such as that which in May, 1878, destroyed ex-Governor Washburn's large mill and killed fourteen persons. Flour and dust in a confined atmosphere are found

to be almost as explosive as gun-cotton, and hence a spark of light often does incalculable damage. Even the running of the empty stones sometimes suffices to strike the fatal spark. Down copper tubes, inclosed in a jacket containing steam, the wheat passes to dry and toughen the skin and facilitate the separation of the bran. Between slack rollers the wheat is cracked, that the bran may be separated with as little flour as possible attached to it. The stones to which it passes, unlike those which grind the soft winter wheats, are run at low speed. Using hard spring wheats, slow movement is found to produce the best quality of flour. The stones, as at home, are dressed with the diamond machine and handpick; but the dressing is generally better done by fewer hands at lower wages, while sharpness is maintained by the use of solvents. From the stones the ground wheat is thrown on to the silken bolting cloths, which carry over their furthest end the husk or bran, discharge into other hoppers the tailings and middlings, in another channel run off the cheaper baker's flour, which has occupied the central layers of the grain, while the germ, situate close to the hilum and containing oil, which discolors and spoils the flour, is also separated as an oily flake, and made into the "red dog"—the lowest quality of flour.

But at Minneapolis and many modern American mills where spring wheat is used still further separation and reduction are effected. The middlings are run repeatedly between stones, iron or porcelain rollers, and through the silk bolting cloths. These processes, first adopted in Hungary, and hence called the Hungarian process, are repeated four times, and in some mills as many as twelve times. From these repeated reductions of the middlings, which constituted the layers of the wheat berry immediately under the bran, and which until recently were almost classed with the refuse, are made the finest qualities of the highly albuminoid or patent flour. This flour has not hitherto been sufficiently appreciated in England. It has, however, much greater strength than the ordinary baker's flour; it takes up more water; it makes lighter bread; a barrel of 196 lb. makes 140 loaves of 2 lb., while the same weight of ordinary baker's flour turns out about 125 similar loaves. Forty-five per cent. of patent flour is sometimes taken, but this large amount reduces unduly the quality of the other grades, and most millers are satisfied with thirty-five to forty per cent. of patent. The better qualities of spring wheat—a grain grown on tolerably fresh, unexhausted soils, and in a favorable, rather dry season—are understood to produce the heaviest yields of patent flour. Both ex-Governor Washburn and Mr. Pillsbury, however, assure me that, with their improved machinery and repeated purifications, although the yield is not so great, they can now turn out of No. 4 wheat as good flour as was formerly made from No. 2.

Very notable in these new mills is the extreme solidity of the whole structure, the absence of vibration, the abundance of air and light, the introduction of air between stones and rollers, and, by a powerful suction draught on the top story, the effectual riddance of the dust, so disagreeable, and as already stated, so dangerous in most older mills. In the upper part of the Washburn B mill is a simple and ingeniously constructed chamber, into which is received from the stores and cleaners the up-draught of dust-laden air, which deposits its burden on a webbing of flannel, which is swept and cleansed from time to time. The ubiquitous handy lifts render communication easy between the several floors, but increase the risks of fire spreading. The large amount of timber used in all American mills also greatly increases their liability to destruction by fire; while, placed near together, as most of the Minneapolis mills are, a serious conflagration would be alarmingly prone to spread. The precautions against fire are, however, admirable; cisterns of water, hydrants, and hose are on every floor; the men are well instructed and drilled, so as to act promptly in case of emergency. Patent safety gas lamps, inclosed in crystal globes, are always kept with a speck still burning, so that, without opening the lamp or the use of a naked flame, the light can in an instant be turned up.

An increasing proportion of flour is exported in sacks, which cost from 12c. to 16c., according as they hold 140 lb. or 200 lb. The smaller are preferable on account of their facility of movement. In sacks, the flour is easily and cheaply packed both on car and on shipboard. The sack, moreover, costs less than one-half the price of the barrel. In sacks, moreover, the full weight of flour is more likely to be insured. In the barrel, however, which costs 42c. to 44c., and weighs 20 lb., the flour is less likely to be injured by being placed in a dirty car or by sea water; while Mr. W. H. Bailey's stamped paper linings, if used, at a trifling cost per barrel, not only aid in preserving the flour, but prevent the common fraud of refilling barrels bearing a superior brand with flour of inferior quality.

British millers and bakers anxiously inquire whether these improved American processes pay. A few figures may afford experts the basis for their calculation. At Minneapolis it appears that 285 lb. to 300 lb. of No. 2 spring wheat, weighing 62 lb. per bushel, are required to make a barrel of flour. About fifty per cent. of this flour is the ordinary baker's qualities; about forty per cent. is the patent, worth about thirty per cent. more than the baker's; about ten per cent. is "low grade," sold at about half the price of the baker's flour. Besides about 10 lb. of waste in the making of each barrel of flour, there is about 80 lb. of bran and offal, worth 10d. to 1s., or sold at the mill at \$5 to \$5.50 per ton of 2,000 lb. This low price of the offal is one of the American miller's disadvantages, which he has hitherto vainly sought to remedy by condensing the bulky bran into a portable form, and thus profitably forwarding it to British markets, where it would be worth about five times the price it brings at Minneapolis. The transport of the flour to European markets, whether in sacks or in barrels, is, however, effected on through bills of lading on terms very favorable for the American miller. By several routes the barrel of flour can be transported from Minneapolis to Liverpool, London, or Glasgow at 5s. to 5s. 6d.

The larger conveniently situated British mills have, however, nothing to fear from American competition. They purchase their wheat in a much wider market. The supplies of the whole world are on offer to them. Wheat off the coast is usually to be purchased on relatively easier terms than it can be bought from the farmer who has grown it or the merchant who has stored it. The transport and insurance charges are about the same as those which the American miller will have to pay upon his flour. But the British miller of means has a further advantage. Many cargoes off the coast are for immediate sale; money has been advanced upon them; their sale being usually imperative within a few days gives the purchaser an advantage which may be estimated at about 1s. per quarter. The Americans have no monopoly of improved machinery. The ingenious and important improvements recently made by American millwrights and engineers are not confined to America. In many modern British mills these improvements are introduced. On two of the largest Lancashire mills American artificers are now at work perfecting and modernizing the machinery and arrangements. As with wheat and meat, American competition in flour notably keeps down prices. British millers have to work for smaller profits. The business passes into the hands of larger capitalists, who work it systematically, and who, with a big turn-over, can afford to do with narrower profits. When the English market is dull and glutted with American flour, the British miller often buys largely, and makes handsome profits at the expense of his American *confrère*. Like his New World competitor, he has his wheat delivered on his premises by barge or rail. Being in bags, it is hauled up by cranes. Elevators are not used so frequently as they are for the loose grain in America. The grinding is done cheaply and effectively. By judicious mixtures of various wheats better results are usually obtained than where one sort only is used. The bakers say that in purchasing from the best English mills they have hitherto got a more uniform and reliable article than when they bought American flour. The British miller, brought into personal contact with his customer, moreover, better understands and supplies his wants; and, lastly, he has the advantage over the American miller in realizing four times the price for his offal.

To the British public it probably matters little whether the staff of life is imported as wheat or as flour. Their chief anxiety is to secure plentiful and cheap breadstuffs, and never was there better prospect of such plenty and cheapness. The British wheat producing capacity is limited. On many British farms it is greatly more profitable to grow other produce, especially of a more perishable description, and which cannot be so readily brought from abroad. Between one-third and one-half the wheat annually required in the United Kingdom must now be imported. Other countries, notably our colonies and the United States, can fill our deficit. For many years to come America, from her surplus, can supply not only the wheat we need, but various other agricultural produce. She has a vast extent of cheap, good land. In the great trans-Mississippi zone, where nearly half the wheat of America is now grown, not one-fourth of the land available for wheat is yet cultivated, or even occupied. Throughout these regions, wheat, as has been demonstrated in these columns, can be profitably raised at 22s. to 25s. a quarter. In many older States and on most farms a little more care in cultivation and in the selection of seed would profitably secure an increment of several bushels per acre over the present meager 12½ bushels—the acreable wheat average of the United States. The enhanced prices of the last six months have greatly extended the wide area devoted to wheat alike in Canada and the States. With anything like a favorable season, America will have a bigger surplus than ever to dispose of. Hitherto she has spared one-third of her great yield, or upwards of 18 million quarters. Future crops will, doubtless, provide still more if it is needed. The transport charges on the American continent and across the ocean add 50 per cent., and sometimes more, to the first cost of these cheaply-grown breadstuffs. Any permanent or considerable rise in these transit rates would obviously affect the price of bread in England; but such rise will be counteracted by the introduction of improved machinery and appliances in the several modes of transport, by competition among carriers by land and sea, by augmented trade insuring the loading of ships and cars going west as well as east, by the reduced wages and expense induced by amendment or removal of the present costly duties which the United States levy on all imports. These considerations favor the conclusion that the present moderate charges are very unlikely to be advanced. A quarter of wheat (480 lb.) is now carried on through bills of lading 1,200 to 1,400 miles by railway cars or barges, and 3,000 miles over the ocean to British ports for about 15s. For 2s. 6d. landing, dock, and other charges are met. With a living profit to all concerned, American wheat can therefore be landed in the United Kingdom at 40s. to 42s. per quarter, and with tolerably favorable seasons this price is not likely to be exceeded.—*London Times.*

THE CARRYING TRADE OF THE WORLD.

GREAT BRITAIN still enjoys a practical monopoly of the carrying trade of the world, and what is more, her preponderance in this regard appears to be increasing rather than otherwise. In 1870 Great Britain possessed 1,111,375 tons of steam shipping; in 1879, the corresponding total had risen to 2,508,102 tons. It is true that the aggregate sailing tonnage of Great Britain decreased from 4,503,318 tons in 1870, to 4,013,187 tons in 1879; still, the combined totals of British steam and sailing tonnage present a very large augmentation during the last ten years. Two facts stand out in clear relief in connection with the figures which we have been summarizing. The first is the tendency of steam vessels to supersede sailing vessels more and more; and the second is the continued possession by England of her old lion's share of the world's commerce. While the amount of foreign tonnage entering and clearing at ports of the United Kingdom since 1874 has barely held its own, that of Great Britain has increased about 84 per cent. The United States feel the effect of this peaceful British assertion of the supremacy of the seas. The clearances of steam shipping—nearly all of it British—from England to the United States rose from 1,445,000 tons in 1875 to 2,148,000 tons in 1879. Statistics illustrating the arrivals and clearances of vessels at the port of New York, in April, illustrate the same fact in an even more impressive manner. The total arrivals of steam vessels at New York in April from all other ports were 110 British steamers to 21 American steamers, while the corresponding clearances were 102 British steamers to 18 American steamers. The American steamers referred to in these figures traded exclusively with the West Indies, Mexico, and South America. Not a single one of them made a trip between New York and a European port. England has a complete steam monopoly of the North Atlantic so far as New York is concerned. Her only competitor on the Atlantic seaboard appears to be Philadelphia, which, with the help of a large annual subvention from the Pennsylvania Railroad Company, is still running four steamers of what is called, with a certain pride, the American line. The maritime ascendency of Great Britain is thus shown to be practically complete.

The facts which we have rapidly summarized show beyond all contradiction that the victory of British steam shipping in the North Atlantic is thoroughly decisive. In the infant stages of the American colonies—and especially in the days of the Stuarts and William of Orange—it was a standing complaint of the colonists that the legislation of the mother country excluded them from all available paths of profitable employment and industry for the aggrandizement of the parent State. Those days have long since passed away, and whether the complaints then made were well founded or not, it is clear that they do not apply to the present century. The shipping interest of this country has now to contend with unrestricted competition, but so far as steam shipping is concerned, it is undoubtedly more vigorous and more powerful than it ever was, and even in the ports of the Great Republic itself. We fancy that this is partly due to the insularity of this wonderful island of ours. Americans may sneer at it as so small that they are almost afraid of falling off from it into the sea, but from the very fact that it is a right tight little island its inhabitants have not to move iron, coal, and other raw materials so far as they have to be moved in the United States. The result is that nowhere, probably, can a large steamer be built so cheaply as it can be built in Great Britain. Then the genius of a large proportion of the British people is essentially maritime. The English take to the sea just as ducks take to a pond, and the hardy sailors of this country are found in every clime. The Americans can furnish, no doubt, a large number of good sailors, but the average American can obtain the necessaries of life so easily that he is not impelled to maritime industry by the same irresistible circumstances which drive so many of our English youths into a career upon salt water. These are the facts and considerations which have to be taken into account when we are dealing with the question of British supremacy upon the seas. After all, we ought to be proud of the fact that in a peaceful fashion Britannia still rules the waves. So long as this is the case, our country can never be condemned to a complete and final decadence.—*Colliery Guardian.*

UTILIZATION OF SMALL STREAMS.

IN general the land bordering upon small brooks, and even larger streams running through farms or fields, is entirely useless, and in many cases is a nursery of noxious weeds and a harbor for vermin. By the expenditure of a little labor or a small sum of money, such useless land may be turned to valuable account. By damming the stream a pond of respectable size may be made, which, stocked with fish, will become a source of larger income than several times its area of the best land upon the farm. Fish culture is too often supposed to be a troublesome and fussy business, in which one may spend much money to little advantage. But I do not propose fish culture. I suggest stocking the pond thus made with fish of a kind easily kept, which will not require to be fed artificially; such kinds, in fact, as will feed themselves.

As a rule, the most desirable things cost for their attainment in proportion to their scarcity and desirability. Trout, among fish, are the choicest kind and the most costly to procure, and it is probable that the man who gets a dollar for a pound of trout grown in a pond has well earned his money. Every one cannot eat trout, as every one cannot drink champagne, but there are agreeable and wholesome fishes as well as wines that cost very little, and the average person may well be contented with them. A perch, either white or yellow, is not far behind a trout in flavor and firmness of flesh, and this fish will thrive in any pond above the character of a mud hole, and in water that is too warm for trout. Eels are easily grown in ordinary ponds, and these are choice meat. Black bass is a choice fish, and may be mixed with chubs and minnows, upon which they will feed. In fact, the kind of fish to be procured is altogether a secondary matter to the making of the pond for them.

MAKING AN ARTIFICIAL POND.

I here describe the manner of making a pond in an easy and inexpensive way, in a situation on a stream so frequently found as to become a typical case. Suppose a stream of four feet in width, or even so small a one as a single foot wide, passing through a gully or small narrow valley, or a wide one, as the case may be. A dam is thrown across the hollow in a convenient place; the best place being where the banks are the steepest and where they widen out above. As the water flowing from the pond may be used for irrigating land lower down the stream, or for other useful purposes, the possibility of this should be made a consideration in locating the dam. The construction of the dam is important, as this is the weak point, and a tight dam is very rarely made. A close union cannot be made between old and new ground, and water will penetrate at the junction. The old surface, to the depth of a few inches, and all vegetable matter, sod, etc., must be removed. To make a substantial dam, and prevent the passage of rats, muskrats, or moles, it is better to make two rows of piling of pieces of planks or boards, sharpened to an edge and driven into the ground at least a foot. This is done in the following manner (see Fig. 1): A wooden box or flume, *d*, is first bedded in the stream, and the earth packed solidly and well rammed on each side of it. This is for the purpose of drawing off the pond, or by opening it to assist the escape of excess of flow in a time of freshet. A row of piling is then made from the box on each side, in the directions shown by the lines, *a*, *a*, until these reach the sides on a level with the top of the intended dam. A wing of tight boarding or planking is then made on each side of the stream, closely joined to the box and the piling, as at *b*, *b*, Fig. 1, and *b*, Fig. 2. A slide gate, *e*, is made in the upper end of the box at its entrance, which is opened to let off or lower the water of the pond when desirable. A second row of piling or planking is then made at *c*, *c*, and is closely fitted around the box. The earth dam is built in the space between these rows of planking, and is well rammed down or puddled as it is wheeled in. Afterwards the dam is graded on the outsides of the planking, with a slope of one foot horizontal to one perpendicular, or at an angle of 45°. It will be all the better if the slope is made one and a half to one, or at an angle of about 35°. The dam should be thickly seeded to grass, which will prevent washing and wasting by rains. The grade of the dam is carried down to conform to the edge of the wings, *b*, *b* (see Fig. 2), and the earth is carefully puddled about the bottoms of these wings. When the dam is finished a waste way, *f*, Fig. 2, is made, over which the stream flows when the pond is filled. The face of the dam is covered with tight boarding, *g*, provided with side boards of sufficient

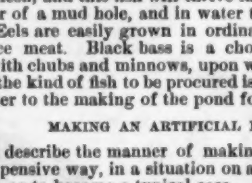


FIG. 1.—PLAN.

height to confine the overflow and convey it down the face of the dam into the bed of the stream, the boarding or apron being carried a few feet down the stream, to prevent washing by the current. When the dam has well settled, a gate (Fig. 3) made to slide in grooves in the face of the box, *d*, is put in its place. This stops the stream and shuts the water into the pond, in which it rises until it flows over the waste way. The gate is made of pine plank 1½ inches thick. An iron rod having a ring at the end of it is fastened to the gate and serves to lift it by means of a lever (seen at *h*, Fig. 2) which is passed through the ring.

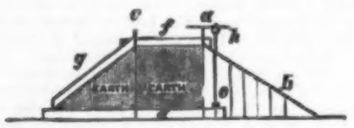


FIG. 2.—SECTION.

The bottom of a fish pond should be uneven; deep holes here and there are desirable; and to make these the earth for the dam should be taken from the bottom of the pond, and should be dug out unevenly, leaving pits here and there in which the fish may hide and retire for warmth in the winter and coolness in the summer. A few large stones should also be gathered from the farm and scattered over the ground to be overflowed; or heaps of small stones may be made here and there. A few stout stakes, with large spikes or hooks in them, to prevent unbidden netting, should be driven in the bottom. These provide rubbing places for the fish, also shelter for small fry; and a good supply of old stumps scattered about will encourage aquatic insects to gather and breed, and these will furnish food. Aquatic plants, as lilies, sagittaria, and others, should be planted in the pond; the more of these, the more abundant will be the

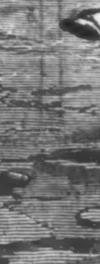


FIG. 3.—GATE.

food supply. Some varieties of fish are vegetable feeders, the European carp notably, and as this newly introduced fish is valuable and easily kept in ponds, it will afford a favorable opportunity for very easy and profitable fish-growing.

An estimate of the value of half an acre of pond surface may be made as follows: Ten pounds weight of fish may be kept in 240 cubic feet of water, if the supply of food is adequate; hence half an acre of an average depth of 3 feet will afford nearly 66,000 cubic feet of water, sufficient in capacity for more than 2,500 pounds of fish. Assuming that a third of the fish will arrive at edible size each year, this will give a supply of 800 pounds of fish annually, or about 15 pounds weekly. Such fish as may be grown in a pond are worth 25 cents a pound, making an annual supply worth $200. The cost of catching may be counted as nothing, and doubtless the contract could be let to the boys at that price! In addition to the fish, the ice may be estimated as worth $50 yearly, amounting as it would to over 500 tons at one foot thick. If only 200 tons were procured, at 25 cents a ton, $50 would be realized. I have known $200 to be realized from the sale of ice from a smaller pond than half an acre—a dollar a load being charged to parties who were glad to cut it themselves at that rate. Something may be realized from the water itself, in its use for irrigating meadows; also water power, which may be utilized in raising and forcing a supply to the buildings and yards, and in other ways which will be found useful in many cases. But if it be used only to procure a supply of fish and of ice, a pond of this kind will prove an excellent piece of property, and after a time will be thought indispensable.—AGRICULTURAL ENGINEER, in *Country Gentleman.*

NATIVE SPORTS AT CANDAHAR.

THIS sketch, for which we are indebted to Lieut. E. A. P. Hobday, R. A., represents some Hazaras performing feats of horsemanship on the plain outside Candahar. The Hazaras, who are of Mongolian origin, settled in Afghanistan at some remote period, but have always been engaged in perpetual feuds with the Afghans themselves, and they have proved valuable allies to us at Cabul and elsewhere. Last year they were invited by General Donald Stewar and Major St. John, the Political Officer, to Candahar, where they were our guests for about a week, an entire day being devoted to their sports. Mounted on wiry little horses, they rode in quick succession past a bottle or other mark placed on the ground, and, unslinging their long guns, fired at it as they passed, leaning low over their horses, and seldom failing to hit. Their fearless riding excited the admiration of all, and their flowing robes, and the wild manner in which they dashed about, rendered the spectacle extremely animated and picturesque.—*London Graphic.*

AFGHANISTAN.—NATIVE SPORTS IN CANDAHAR.

TAR, PITCH, AND TURPENTINE.

TURPENTINE is the sap in its natural state as it flows from the tree. Tar is made by charring the dead limbs and wood in kilns. Pitch is tar reduced about one-half by evaporation. Spirits of turpentine is obtained by distillation from turpentine, including scrapings. Rosin is the residuum left by distillation.

RAILROAD SINKS.

THE sinking out of sight of several hundred feet of the New York, New Haven and Hartford Railroad near Meriden, Conn., a few days ago, and the statement in Connecticut newspapers that the incident was something heretofore unheard of in the construction of railroads in this country, has recalled several interesting incidents of difficulties encountered in building railroads over subterranean lakes in this vicinity during the past few years.

In 1870, when the Monticello and Port Jervis Railroad was being graded near Gilman's, it was noticed that the ground for several rods was moist and shaky. It required much filling to make a solid road-bed. A year afterward, the road having been in operation several months, the watchman of that section of the track was walking along the railroad just after the passenger train to Monticello had passed the spot. Suddenly he saw the railroad embankment gradually sinking for a long distance ahead of him. He ran to a high bank at the side of the road just as the railroad dropped with a loud noise, 15 feet below the surface. It required days of labor and the driving of long piles to construct a secure foundation for the rails.

The New Jersey Midland Railroad was constructed in 1870 through the northern part of New Jersey, and was graded over a marshy place between Snufftown and Fort Turtle. One night the laborers quit work, after several days' labor, having almost completed the work at that point. When they went to their task the next morning they were amazed to see that where the road-bed had been was a pond of thick, muddy water, 600 feet long and 25 or 30 wide. The men attempted to sound the depth of the mysterious pond, but an iron rod 40 feet long failed to reach any foundation. The swampy flat where this phenomenon was witnessed was once heavily timbered, but a portion of it had been cleared and used for meadow land. Its surface was such, however, that a team could not be driven over it, and a person in walking across any of the meadows would cause the surface to shake for several feet around. Near by there are "boiling springs," so called from the manner in which the water gushes out of the earth. The water of these springs is of excellent quality, and never varies in volume, streams of moderate size being formed. If the stories of people living in the vicinity are true that curious-looking fish without eyes have been taken from these springs, the theory that a vast underground lake exists there would seem to be proved beyond doubt. All the surroundings indicate that a natural pond or lake once covered the surface, but what should have transformed it into a subterranean body of water is a mystery. An examination of the spot was made at the time of the sinking of the railroad grading by several scientific men, and they were of the opinion that the lake had been incrusted by the accumulating vegetable matter of numberless ages, until a surface had formed sufficient to sustain forest growth. The boiling springs were regarded as outlets to the subterranean lake. Whether these speculations were based on truth or not, there was no doubt that the railroad had been submerged, and, as there was no thoroughfare for the road anywhere else in the vicinity, the gigantic task of making a substantial road-bed in the Snufftown Sink, as it was called, had to be accomplished or the railroad

enterprise abandoned. Bottom was found at a depth of 90 feet. Nearly two months were occupied in overcoming the swallowing-up capacity of the sink. It was a week before any effect of the vast daily work of dumping thousands of cart-loads of gravel, hundreds of trees, rocks, etc., into the sink was noticeable. A solid bed was made, however, and no difficulty has ever been experienced from any settling of the track.

The Jefferson Branch of the Erie Railway was built in 1872-3. It is a coal-carrying road, and climbs the lofty hills of Northern Pennsylvania from Susquehanna to Carbondale. When it was in course of construction the road-bed for a distance of a quarter of a mile disappeared one night. An apparently bottomless bog appeared in its place. Into this pit 10,000 cart-loads of gravel, and over 500 hemlock trees, branches and all, were thrown, without having any visible effect toward forming a bottom. A pile 40 feet long was then driven down its entire length. Upon it another one of the same length was placed and driven down, and still no bottom was found. Four of these long timbers were forced down, one on the other, before solid foundation was reached, proving that the bog, or lake, or sink, was 160 feet in depth. The existence of this curious formation at this spot was the more remarkable because it was on the summit of a ridge 2,000 feet above tide, and all around it were rocky hills and ledges. George S. Redington was then Superintendent of the Delaware Division of the Erie. He had a line of piles driven, as above described, along both sides of the space desired, on which to construct the road-bed. The piles were driven close together, and formed subterranean booms, that prevented the passage of anything thrown into the space. The trees were cut off of three acres of land, and a hill containing four acres of gravel was leveled to obtain material sufficient to make any kind of a foundation for the track. The filling of this great sink was probably one of the greatest tasks ever undertaken in railroad building in this country.

A curious instance of this kind occurred on the White Hall and Plattsburg Railroad, in 1872, near Crown Point. A number of laborers were engaged in repairing the road-bed, gravel being carried to them from a bed some distance away by a gravel train. The train had just unloaded at the spot where the men were working, and when the engineer started to return to the gravel-pit he noticed something wrong with the rails. Upon examination, with the foreman, he found that the rails had moved several inches. They ran on some distance in order to see if the grade had changed any, when suddenly the track, with train and all, dropped with a crash a distance of 20 feet. The fireman was alone on the engine, the engineer and foreman having alighted to examine the track just before the sink occurred. He was assisted to the surface as the banks on either side began to cave in upon the locomotive, which was buried a half minute later. The earth on all sides opened in large fissures, 4 to 6 feet wide and 50 feet deep, and the surface of the earth for 300 feet was changed into a series of hummocks and gullies.

The phenomenon of the incrustation of sheets of water, which, in the lapse of time, became solid earth apparently, forms an interesting subject for scientific investigation. The process of this incrustation may be witnessed at Amber Lake, in the town of Bethel, Sullivan County. A large portion of the shores of that delightful little sheet of water is a floating morass, which, near the water's edge, is too thin to sustain the weight of a grown person, but seems firm and solid as the shore is approached. The work of covering the water with vegetable matter goes steadily although slowly on, as all the surroundings plainly attest.—*Port Jervis Correspondent New York Times.*

THE VESUVIUS RAILWAY.

WE have already engraved a general view of this new mountain railway, and also the form of carriage which is used on the line (see SUPPLEMENT, 235), and we now illustrate the starting of the first train, on June the 6th, 1880, when the line was formally inaugurated, in the presence of a crowd of officials and others who had been invited to take part in the ceremony. The first train, or rather carriage, ascended with the greatest ease, amid general applause, bands of music playing the Italian Hymn. The carriages are two in number, being named respectively Etna and Vesuvius, and while one ascends the other descends. The ascent, occupying about eight minutes, is perfectly easy and comfortable; and, though the incline appears somewhat hazardous, the line is perfectly safe. The carriage lands the traveler within about ten minutes' climb of the crater. The descent is perhaps less pleasant than the ascent, for the feeling has been compared to the sensation of driving down the Splugen on the Swiss side in a diligence, only much intensified. The cost of the line has amounted to about £60,000, and the scheme is due to Commendatore Obliegh*t*, having been admirably executed by Signor Olivieri and Signor Luigi dall' Ongaro.—*London Graphic.*

THE VESUVIUS RAILWAY.

REDDENING OF CARBOLIC ACID.—This change of color, which is occasionally observed in the purest carbolic acid, is ascribed to the absorption of ammonia, or rather of ammonium nitrite, from the atmosphere. In glass vessels hermetically sealed no change of color takes place.—*H. Hager, in Pharm. Centralhalle.*

BOILERS SET IN MASONRY.

CHIEF-ENGINEER ISHERWOOD, U. S. N., in a recent paper in the *Franklin Journal*, condemns the firing of boilers in masonry, as being uneconomical. He says:

During the many experiments on boiler vaporization made or investigated by the writer an inferior result was always found with boilers of the same type, having the same proportions of heating to grate surface, and of calorimeter; burning the same coal at the same rate of combustion per hour per square foot of grate surface; but having their furnaces and flues in brick masonry instead of in iron shells; and just in proportion to the extent of the brick surface with which the gases of combustion were in contact.

Whenever the highest vaporization is desired from the fuel consumed at a given rate of combustion, brick settings should be wholly discarded and all parts of the boiler arranged within an iron shell; and the difference will be the greater with boilers having the least ratio of water-heating to grate surface, because in them the gases of combustion enter the chimney with the highest temperature, and the infiltered air carries off a correspondingly greater quantity of heat. Were it possible for the gases of combustion to leave the boiler with the temperature of the atmosphere, there could, of course, be no economic loss by any amount of air leaked in, for whatever heat was imparted to it on entering would be yielded up before leaving; the loss will be just in proportion to the temperature of the chimney, other things equal.

When it is considered that walls of brick masonry are easily pervious to water, there can be no difficulty in believing they are still more easily permeable by air. If brick-work be adopted for the setting of boilers, an air space of about two inches width should be left in the masonry, whose entire exterior should be well coated with pitch, or with a cement of mastic, to stop the inleakage of air as much as possible. This, however, the writer has never known done; and he has always observed that, after a short period of use, the masonry was more or less warped by heat, and cracked, the inleakage of air becoming correspondingly increased.

When a boiler set in brick-work is used during only a portion of the day, as is generally the case, a serious loss of fuel is experienced in heating the mass of masonry from the temperature it has when the boiler is out of use to its temperature when the boiler is in operation. This loss is measured by the weight of the masonry into the product of its specific heat by the difference of the temperatures stated.

A boiler set in brick-work will also lose more heat by radiation than one whose gases of combustion are wholly within its shell, because the first will have a greater external surface

than the second, and because the temperature of the gases of combustion are on one side of the setting, while in the case of the second the temperature in contact with the felt or other covering is only that of the contained steam, or about half as much. In either case, however, the loss by external radiation of heat is comparatively trifling.

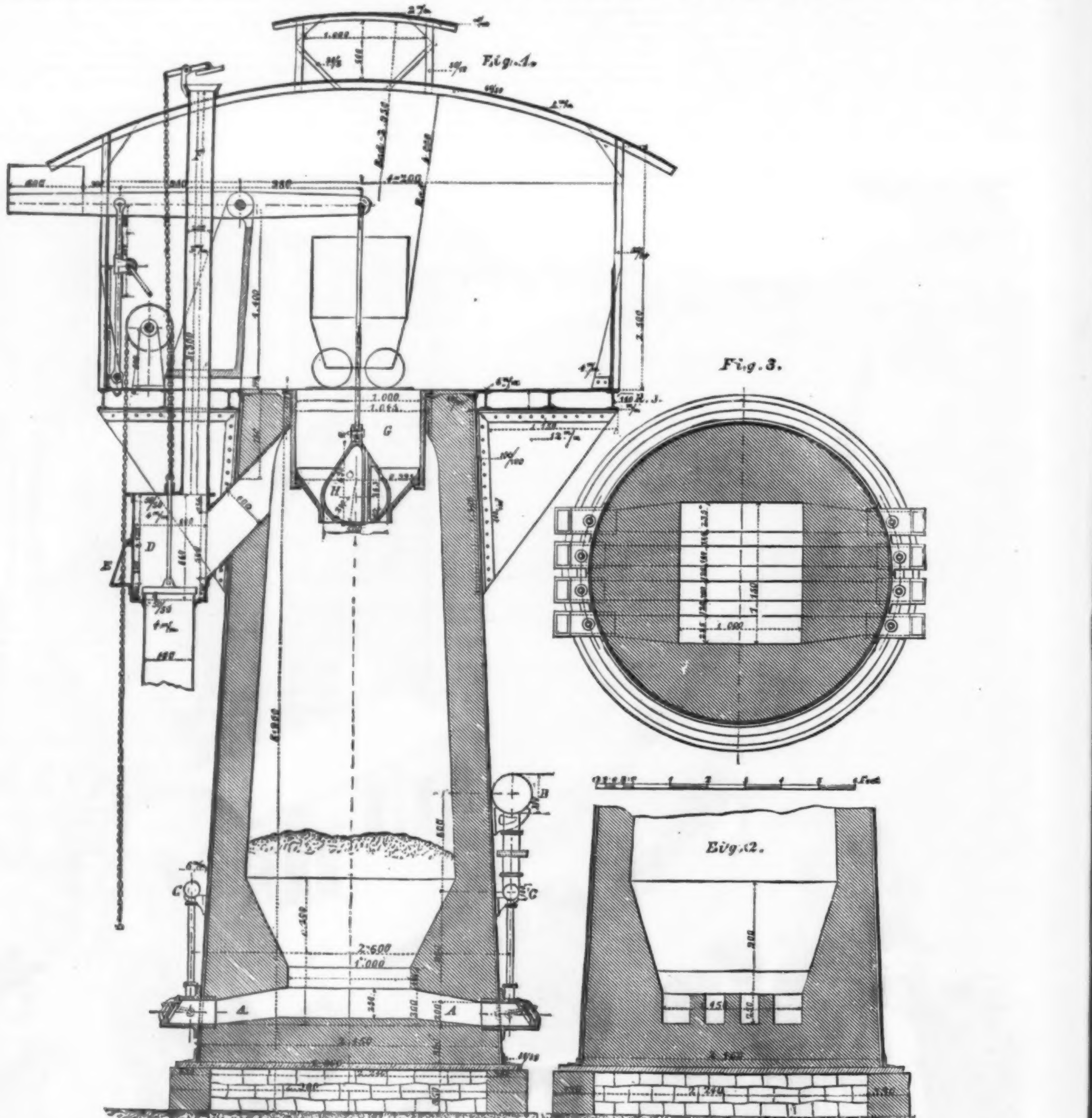
THE TESSIE GAS PRODUCER.

In general appearance the Tessie gas producer, devised by M. Tessie du Motay, of Paris, the well-known chemist and metallurgist, resembles a small close-topped blast furnace fitted with the cup-and-cone charging arrangement, G H, now generally adopted for such furnace. A special feature, however, is the form of the hearth and the manner in which the air supply is arranged.

As will be seen from our engraving the hearth is cylindrical, and has a brick bottom, on which are formed four channels, each communicating at its ends by passages, A A, with cast-iron mouthpieces or wind boxes, these wind boxes being connected by branch pipes with an annular blast main, C, which is in its turn connected to the blast main, B. The mouthpieces just mentioned are furnished with doors which can readily be removed to allow of the insertion of a bar for clearing the air passages or lifting the mass of fuel.

The gases produced are led off by a side opening to the valve box, D, to which the down-comer is connected, and which is also furnished with a cleaning door at E. To this valve-box is also connected the chimney, F, through which the gases escape, when the communication with the down-comer pipe is shut off.

The pressure of blast employed is equal to a head of 200 millimeters, or about eight inches of water, while the pressure at which the gas is taken off is equal to a head of six millimeters, or rather under $\frac{1}{4}$ inch of water. The consumption of coal in a gas producer of the dimensions shown is 100 kilogrammes, or say two cwt. per hour, this coal being small dust coal of very inferior quality, and containing from 20 to 30 per cent. of ash. The cleaning of the fire is stated to occupy about three minutes every two hours, while MM. Wendel inform us that the gas yielded is of excellent quality, and the labor of working the producer very small.—*Engineering.*



THE TESSIE GAS PRODUCER AT THE WORKS OF MM. DE WENDEL, LORRAINE.

HIGH RAILWAY SPEEDS.

By W. Barnet Le Van.

Railways being now the common highways of our country their managers naturally seek all means of accommodating and meeting the wants of the traveling community.

The active rivalry now existing between the Pennsylvania Railroad and the Bound Brook Route of the Philadelphia and Reading Railroad has resulted in giving us the most improved facilities for communication between the two principal cities of this country, and has placed our railway speed on a par with the fast time of the British express trains.

It is but a few years ago that a trip to New York and back in the same day was considered a wonderful achievement; the time occupied, being three hours each way, was thought very short, whereas to-day one can have his breakfast and go to New York, transact business and return and dine in his own house. But even the great reduction of time has not been considered sufficient to comply with the requests of rapid transit, and the two roads referred to are contemplating and preparing to run the ninety miles between Philadelphia and New York in ninety minutes.

Sixty miles an hour, as it strikes the ear, does not seem an impossibility, but if we look at it in all its bearings, and consider that it means *one mile in one minute*, or sixty *miles in sixty consecutive minutes*, it begins to assume proportions that seem insurmountable.

Some of the earliest locomotives ever built have run over a mile a minute, and in one instance a speed of ninety three miles per hour was maintained for a few miles.

To illustrate more clearly the difficulties in running sixty miles in sixty minutes, the locomotive must be capable at all times of developing *seventy miles per hour*, so as to meet any contingency that may arise. A locomotive at seventy miles an hour passes over one hundred and two feet per second $\left(\frac{70\times22}{15}=102\cdot6\right)$. Two objects near a person, say three feet apart, pass his eye in the thirty-fifth part of a second. When two trains having this speed pass each other the relative velocity will be two hundred and five feet per second; and if one of the trains were one hundred and two feet long, it would flash by in a single second. To accomplish this, supposing the driving wheels to be six and one-half feet in diameter, and the piston to change its direction in the cylinder ten times in a second, there being two cylinders to every locomotive, and the eccentrics being so adjusted that the exhaust steam discharges alternately, there are twenty discharges of steam per second, at equal intervals, and these twenty exhausts divide a second into twenty equal parts, each puff having a twentieth of a second between it and that which precedes and follows it. The ear, like the eye, is limited in the rapidity of its sensations; and, sensitive as those organs are, they are not capable of distinguishing sounds which succeed each other at intervals as short as the twentieth part of a second.

Therefore, to run sixty miles in sixty minutes continuously and with a reasonable degree of safety, some modification in the form of engine as now built must be made. The road bed must also be in the best condition attainable, and as straight as possible, and if curves are indispensable they should not be less than two thousand feet radius.

Locomotives are distinguished as *single* or *coupled*, independently of their kind or class. When only a single pair of driving wheels is employed, the engine is said to be a single engine. When two or more pairs of driving wheels are used, connected by coupling rods, the engine is said to be coupled.

When six coupled wheels and a swing "pony truck" in front, connected by equalizing beams with the leading pair of coupled wheels, it is called *Mogul*, and when eight coupled wheels and "pony truck," it is called *Consolidation.*

To accomplish sixty miles in sixty minutes, the Baldwin Locomotive Works, of this city, have just placed on the Bound Brook route between this city and New York a new single engine, similar to those used on the fast lines in England, having but one pair of driving wheels, $6\frac{1}{2}$ feet in diameter. The ordinary driving wheels of passenger engines in this country do not exceed $5\frac{1}{2}$ feet, and two pair coupled together are used. For fast speeds, with coupled driving wheels as in ordinary use, the momentum of the parallel rods which connect the driving wheels becomes enormous, and is a source of great danger. Within a month past the parallel rod of an engine on the Pennsylvania railroad broke. It demolished the cab of the engine, and seriously injured the engineer, and detained the train over one hour.

This new engine requires no parallel rods, and the increased diameter of the wheels also reduce the number of revolutions to the mile, as well as the centrifugal force.

In the ordinary locomotive with small and coupled driving wheels, the greatest speed of the piston reaches sometimes about 1,200 feet per minute with a two foot stroke and 5½ feet diameter driving wheels, giving about fifty-nine miles per hour; but with driving wheels 6½ feet diameter, and the same piston speed, the running rate would be about *sixty-nine miles* per hour. No more adhesion is required at high than at low speeds, assuming the load to be the same. The truth is that the amount of adhesion required to turn to account the whole power which a locomotive is capable of developing varies, inversely, according to the speed at which the engine is run, the higher the speed the less being the adhesion required. The increased resistance, according to experiments made, is in a less ratio than that of the simple velocity, so that the boiler need not exceed the limit of space afforded. The ordinary locomotive boilers do not exceed 1,100 feet of heating surface and 20 square feet of fire grate. In this new locomotive the boiler has about 1,400 square feet of heating surface and about 56 square feet grate surface.

The dimensions of the engine are as follows:

Diameter of cylinders, in inches	18
Length of stroke, in inches	24
Diameter of driving wheel, in inches	78
Wheel-base, in feet	21 ft. 1 in.
Distance from center of driving wheel to center of trailing wheel, in feet	8

BOILER.

Boiler made of steel $\frac{7}{16}$ inch in thickness.
Diameter of boiler, 52 inches.
Number of tubes, 198, and 2 inches diameter.
Length of tubes, 12 feet 2¾ inches.
Fire-box, 96½ long by 84 inches.

TENDER.

Capacity about 3,800 gallons.
Wheels, 36 inches diameter.
Weight, filled with water and coal, 70,000 pounds.

[For engravings of this new engine see SCIENTIFIC AMERICAN SUPPLEMENT, No. 231.]

The Bound Brook road is not fitted with water troughs between the tracks, so that the locomotive tender can pick up its water while in motion; thus, larger tenders are needed to convey sufficient water for the through trip.

By dispensing with the coupling rods and reducing the centrifugal force of the driving wheels it is evident that the design of the engine is in the right direction for safety and fast running.

The tractive force of each pound of effective pressure per square inch on the pistons which this engine is capable of exerting will be

$$\frac{18^2\times24}{78}=99\cdot68 \text{ pounds.}$$

In running sixty miles per hour, on an ordinary road, which corresponds to about 258 revolutions, or a piston speed of 1,034 feet per minute, and a mean effective pressure of about 35 pounds per square inch, the tractive power exerted will be

$$\frac{18^2\times24\times35}{78} = 3,489 \text{ pounds}$$

for each piston, and the horse-power for the two cylinders will be

$$HP = \frac{18^2\times1,034\times35}{33,000}\times2=552\cdot72$$

To run a train sixty miles in sixty minutes between Philadelphia and New York would not be considered as remarkable, provided the track was always clear; but several large towns, cities, and bridges, some of which have draws, are, however, scattered along the route, necessitating a material reduction of speed in passing them, and thus time is lost, which must be made up by a proportionate increase in speed on those parts of the roadway which are clear and unobstructed. This increased speed must be as great, at times, as *seventy miles* an hour, as before stated.

On Friday, May 14, 1880, I received an invitation from Messrs. Burnham, Parry, Williams & Co., to make a trip on a train to be drawn by their "new departure locomotive, No 5,000," the 5,000th of their build (Philadelphia and Reading Railroad Company's No. 507), from Ninth and Green streets to Jersey City, over the Bound Brook route, without stopping, and return in the same way.

As before stated, this locomotive has only one pair of driving wheels, 78 inches in diameter.

The weight is so disposed upon the wheels that by an alteration of fulcrum points operated by a separate steam cylinder, additional weight can be thrown on the drivers at the time of starting. This shifting of the weight will give from 8,000 to 9,000 pounds additional on the driving wheels.

The weight of the engine, ready for attaching to the train, is 85,000 pounds, and the tender 70,000. The train going to New York consisted of four day (set up) cars, of the usual pattern, each weighing about 42,000 pounds. Weight of the train complete, about 148 tons.

THE START.

When the engine left the round house, to take its place at the head of the train, I was reminded of what Elihu Burritt says, when writing about the locomotive:

"I love to see one of those huge creatures, with sinews of brass and muscles of iron, strut forth from his stable and salute the train of cars with a dozen sonorous puffs from his iron nostrils, then fall back gently into his harness.

"There he stands champering and foaming upon the iron track, his great heart a furnace of glowing coals, his lymphatic blood boiling within his veins; the strength of a thousand horses is nerving his sinews; he pants to be gone. He would drag St. Peter's across the Desert of Sahara, if he could be hitched on."

The signal to go ahead was given at precisely 11.16 A.M., and on account of Ninth street being more or less obstructed by teams crossing, 9½ minutes was consumed in reaching Wayne Station, distance 4·3 miles, rate of speed, per hour, 27·15 miles.

Wayne Station to Jenkintown, distance 5·8 miles, time 6·75 minutes, rate of speed 51 miles per hour.

Jenkintown to Yardley, distance 20 miles, time 19 minutes, rate of speed 63 miles per hour.

Yardley to Trenton Junction, distance 2 miles, time 2¼ minutes, rate of speed 53·3 miles per hour.

Trenton Junction to Bound Brook, distance 27·1 miles, time 25¾ minutes, rate of speed 63 miles per hour.

Bound Brook to Elizabeth, distance 20·7 miles, time 20¾ minutes, rate of speed 60 miles per hour.

Elizabeth to Jersey City, distance 11½ miles, time 14 minutes, rate of speed 49·3 miles per hour.

Total time from Ninth and Green streets, Philadelphia, to Jersey City, 89·4 miles, 98 minutes, rate of speed 54·73 miles per hour.

THE RETURN.

On the return trip one car was added, making the total load 168 tons.

Left Jersey City at 2·07 Philadelphia time, reached Elizabeth at 2·21½, distance 11½ miles, time 14½ minutes, rate of speed 47½ miles per hour.

Elizabeth to Bound Brook, distance 20·7 miles, time 19 minutes, rate of speed 65·3 miles per hour.

Bound Brook to Trenton Junction, distance 27·1 miles, time 26·8 minutes, rate of speed 60·6 miles per hour.

Trenton Junction to Yardley, distance 2 miles, time 2¼ minutes, rate of speed 53 miles per hour.

Yardley to Jenkintown, distance 20 miles, time 20·8 minutes, rate of speed 57·6 miles per hour.

Jenkintown to Wayne Junction, distance 5·8 miles, time 8 minutes, rate of speed 43·5 miles per hour.

Wayne Junction to Ninth and Green streets, distance 4·3 miles, time 8½ minutes, rate of speed 30·3 miles per hour.

Total time from Jersey City to Ninth and Green streets, Philadelphia, 100 minutes, distance 89·4 miles, rate of speed 53·4 miles per hour.

The best performance during the trip was in running the 2·8 miles from Willitt to Langhorne, part of which distance is an ascending grade of 16 feet per mile, in two minutes, being at the rate of *eighty-one miles per hour.*

A careful examination of all the bearings at the end of each trip showed them to be perfectly cool, which is something extraordinary for a new engine, running 90 miles without stopping.

To show the speed this engine is capable of performing, on a former trial she ran 13·8 miles in 10½ minutes, or at the rate of *seventy-eight and eighty-five hundredths* of a mile per hour.

Some idea of the steaming capacity of the boiler may be had from the fact that a No. 9 Sellers injector, which will throw 2,000 gallons of water per hour, will not keep her supplied.

The water consumed in the 98 minutes' run to Jersey City was about 3,300 gallons, and on the return trip about 3,600 gallons, or about 34½ gallons, or 288 pounds per minute.

Comparing this time with the fast time made by the 7·35 A.M. going east and the 3·30 P.M. coming west, on the Pennsylvania Railroad from Germantown Junction to Jersey City and return, we have as follows:

PENNSYLVANIA RAILROAD.—Germantown Junction to Jersey City, distance 84·2 miles, time 106 minutes, rate of speed 47·7 miles per hour.

READING RAILROAD.—Wayne Junction to Jersey City, distance 85·1 miles, time 88½ minutes, rate of speed 57·6 miles per hour.

Jersey City to Germantown Junction, distance 84·2 miles, time 103 minutes, rate of speed 49 miles per hour.

Jersey City to Wayne Junction, distance 85·1 miles, time 91½ minutes, rate of speed 55·7 miles per hour.

Being seventeen per cent. less time going east and twelve per cent. coming west than that now made by the Pennsylvania Railroad.

The advantage of large diameter for driving wheels is in the reduction of the number of revolutions per mile. In the Baldwin engine the revolutions per mile are $\frac{1680}{6\cdot5}=258$, and those of the Pennsylvania Railroad, with a 5½ foot wheel, $\frac{1680}{5\cdot5}=305$, an increase of $\frac{305-258\times100}{305} = 15\cdot4$ per cent., and their engines being coupled, this additional number of revolutions adds to the risk by increasing the momentum of the parallel rods and tending to separate them.

It must not be supposed that 80 miles an hour is the limit of speed which a railway train may attain. Speed is a question of power and resistance, and velocities greater than 80 miles an hour, which is about 7,000 feet per minute, are in use in various kinds of machinery, to wit: fan-blowers, circular saws, etc.

The writer believes that before the expiration of five years with the present active rivalry, passengers will be set down in New York in one hour's time from this city.

The following table shows the speed in miles per hour of the *fast lines* in Europe and America:

Engines with one pair of drivers are not new in this country. The *Ironsides*, built by M. W. Baldwin in 1832, had but one pair of drivers, 4½ feet in diameter. Mr. William Pettit ran her on the Philadelphia and Germantown Railroad at the rate of 62 miles per hour. Dr. Patterson, of the University of Virginia, and Mr. Franklin Peale were on the engine, and timed its working on that occasion.

In 1849 Edward S. Norris, of Schenectady, built for the then Utica and Schenectady Railroad the *Lightning*, Crampton, with 16 inch cylinders, 22 inch stroke, and a single pair of 7 foot wheels, which ran at the rate of 60 miles an hour in the year 1850, but it only worked a short time.

Messrs. M. W. Baldwin & Co., in August, 1849, delivered to the Vermont Central Railroad an engine, the *Governor Paine*, with 17 inch cylinders, 20 inch stroke, and a pair of 6½ foot driving wheels, and subsequently sent three Crampton engines, of smaller dimensions, to the Pennsylvania Central Railroad in September, 1849.

Norris Brothers made seven engines for the Camden and Amboy Railroad, each with a single pair of 8 foot driving wheels, and a 6 wheeled truck. The first of these, with 13 inch cylinders and a 34 inch stroke, was sent from the makers' shops, April 17, 1849. The next of the class had 13×38 inch cylinders, and were delivered Dec., 1849. The last of the series, delivered in April, 1853, had 14 inch cylinders and a 38 inch stroke. The 13 inch cylinders weighed, empty, 40,754 pounds, and loaded, 49,253 pounds. Of the weight loaded, 18,496 pounds, or about 8¼ tons, were on the driving wheels, with about 13¾ tons on the truck, making 22 tons in all. These engines had boilers 36 inches in diameter, with plates but $\frac{5}{16}$ inch thick.

In 1850 they also built two outside cylinder engines, with 14 inch cylinders, 32 inch stroke, and coupled 7 foot driving wheels, for the New York and Erie Railroad (new Erie Railway).

In the year 1849 Ross Winans, of Baltimore, built a single locomotive for the Boston and Worcester Railroad It was for an experiment in coal-burning, and constructed to burn anthracite coal. This locomotive was named the *Carroll of Carrollton*. It had one pair of 7 foot driving wheels and was intended for very high speed. It had two small steam cylinders placed on the sides of the boiler, over the bearings of the driving axle, by which the weight on the drivers could be varied from three to twelve tons.

The 7 foot drivers were cast with chilled rims and were of extremely light pattern; in fact they became broken after running six weeks. These were replaced with a set of imported wrought iron wheels, the first of the kind brought to this country.

The speed of the engine, under favorable circumstances, was one mile in sixty seconds. It was run between Albany and Boston, and the train consisted of from seven to eight cars, and made a mile a minute with ease. The engineer, J. H. Jackman, says: "Since I run her in 1849, I have traveled many thousand miles on locomotives, and have seen some high speeds made, still I have never seen the locomotive that could lay right down to it and out-run the *Carroll of Carrollton*. When I run her we made many stops, and therefore could not make better time than locomotives having smaller driving wheels. But give me fifty or sixty miles on a clear run, and I could out-run a thunder storm if it was going our way. In those days we had no air-brakes, and to run at such high rates of speed sometimes became dangerous. I remember one instance, in the night time, of rounding a curve at about sixty miles per hour, when a danger signal met my view. I shut off steam and whistled down brakes, but they did not seem to check me. I whistled again; still the speed kept up. I gave the third signal for brakes, and then reversed my engine, saying to her, 'Do your duty, my beauty, or in twenty seconds it is good by to railroading.' We came to a stand-still eighty rods from a train on the main track, having run one mile and a quarter from the place where I first discovered the red light. A locomotive engineer, to avoid trouble, must take time by the forelock—in other words, must anticipate possibilities."

Not over a dozen and a half of single engines have been made in the United States. Smaller wheels have been substituted for nearly all of these engines, from the fact that all the large-wheeled engines had small boilers, and with a single pair of driving wheels the adhesion was in all cases insufficient for the want of a proper distribution of the weight excess, as in the case of the *Carroll of Carrollton*, and, as before stated, the adhesion weight could be varied between three and twelve tons.

The present Baldwin has a similar arrangement, as before

DESTINATION.		Name of Railway.	Distance between stations in miles.	Time between station, hours and minutes.	Average miles per hour includ'g stops.
Paris to	Marseilles		539	15·21	35
	Lyons		320	8	40
Berlin to	Cologne		364	9·26	38½
	Magdeburg		88¾	2·7	42
Spandau to	Stendal	Berlin and Hamburg.	57½	1·22	42
London to	Edinburgh	Great Northern	397	9·30	42
	Plymouth	London and South Western	246½	6·15	41
	Holyhead	North Western	268	6·35	43
	Swindon	Great Western	77¼	1·27	53½
	Rugby	North Western	82¼	1·42	48½
	Leicester	Midland	99	2·13	44½
	Peterborough	Great Northern	76¼	1·32	50
New York to	Philadelphia	Pennsylvania Railroad	90	2.05	43
	Washington	"	230	6	38
	Boston	"	233	7·11	32
	Cincinnati	"	757	26·30	28
	Pittsburg	"	444	13·30	32
	Chicago	"	912	34·20	26½
	Albany	Hudson River	143	4·05	35
	Philadelphia	Bound Brook	90·4	2·10	41½
Jersey City to	Wayne Junction	"	85·1	1·47	47
	Germantown Junction	Pennsylvania Railroad	84·2	1·43	49
Philadelphia to	Chicago	"	822	23·50	35

The mean average of all the English railways is 46·2 miles per hour; French, 37·5 miles per hour; German, 40 miles per hour, and American, 37 miles per hour; the English being 20 per cent, faster than in this country.

With them, 6½ foot driving wheels are quite as common as 5½ foot wheels are with us; in fact some of the fast lines have eight and nine feet, and one line had ten feet diameter.

described, also the great advantage of a large boiler with ample heating and grate surface.

The Great Western Railway of England has seven foot gauge and was the fastest road in the world until a few years since, and its express ran regularly from Paddington (London) to Bristol, 118¼ miles, in precisely two hours, being at the rate of *fifty-nine miles* per hour.

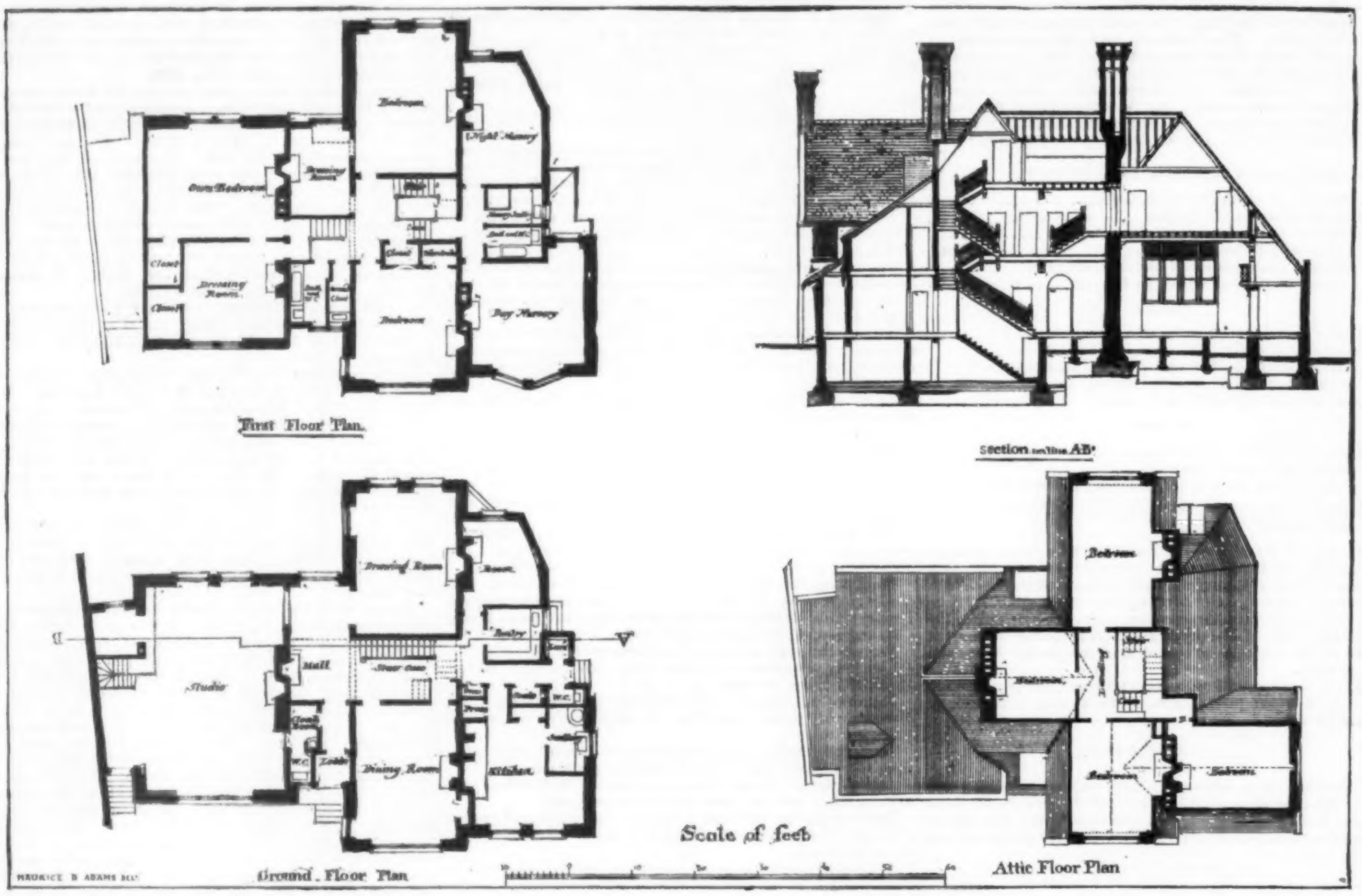
The engines have 18 inch cylinders, 24 inch stroke, 8 foot driving wheels, and those of the largest size have 21 square feet of fire grate and a total heating surface of 1,952 square feet. It has been said of them that they would evaporate from 300 to 360 cubic feet of water per hour, and are known to have worked up to quite 1,000 indicated horse-power. At 60 miles an hour, 1,000 horse-power would correspond to a mean effective pressure of 77·16 pounds per square inch upon the pistons (1851).

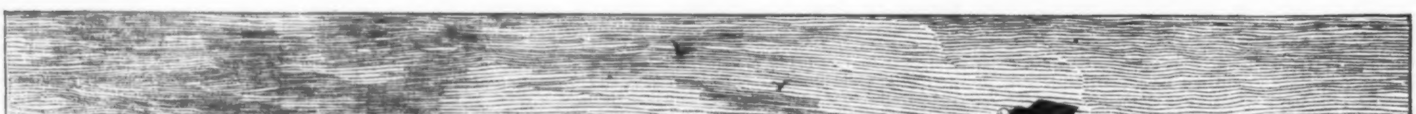
The difficulties so far for very large wheeled engines upon the narrow gauge are these: If the boiler is over the axle, the engine is top heavy; if the boiler is beneath the axle of any pair of driving wheels less than 12 feet in diameter, the form of the fire box and disposal of the tubes are unsatisfactory; while, if the driving axle is behind the fire box (as in Norris Brothers' engines for the Camden and Amboy Railroad) hardly enough weight can be secured for adhesion. A large wheel, moreover, implies a large boiler, and not only is it difficult to provide room in a narrow gauge engine for a very large boiler, but, beyond a certain size, there is a chance of failure under high pressures.—*Jour. Franklin Institute.*

ARTISTS' HOMES.—No. 4.

MR. COLIN HUNTER'S HOUSE, KENSINGTON.

The subject of our illustration is located in a retired part of Kensington, in the Melbury Road, Holland Park, and has all the characteristics of a suburban dwelling, with an unprotected frontage closely arranged with reference to the public road. "Lugar Lodge" is in immediate command of a true north light, and this has been skillfully made the most of by Mr. J. J. Stevenson, the architect, in designing Mr. Hunter's studio, the chief window of which is seen to the





ARTISTS' HOMES, No. 4.—LUGAR LODGE, KENSINGTON.—Mr. COLIN HUNTER'S HOUSE AND STUDIO.

left hand of our perspective view. By this drawing, executed as it is from sketches on the spot, aided by a good photograph by Messrs. Bedford Lemere, the architectural treatment chosen by the architect at once proves the wisdom of the change which was made, after the contract drawings were signed, from a more cottage-like style of building that had first been determined upon. The external walls are of red brick, having cut-brick jambs, reveals, and arches, the carved panels and gables being executed in the same material. Stone moulded sills are used to all openings, and with much success, in a manner quite in harmony with the style chosen. This is a point of considerable interest and importance, inasmuch as cut-brick sills are always more or less faulty, while lead aprons are very frequently objected to for more reasons than that of appearance, and Portland cement, with tiles as a finish, over cut-brick sills, cannot in any way be considered a good or neat method. The roofs here are covered with red tiles, and the external sashes and frames are finished in white, the doors and side-lights being painted a dark bronze green. The chimney in the center of the right end gable, immediately over bedroom window, does not come at all happily, and the angle window of the day nursery, projecting simply from a recessed wall, is by some found fault with for this very reason, that the main wall seems to be set back only to bring the window forward. Entering by a well-sheltered porch, through a good-sized lobby, which protects the hall from north winds, the visitor cannot help observing how nicely the fittings and joinery details are executed in the hall vestibule of the house. At the end a conservatory is screened by a trellis from the glasshouse studio adjoining, the former opening into the drawing-room by its side window. The color of the hall and staircase wall is salmon red, the woodwork being throughout these parts a very dark green with cornices in drab, and ceilings in blue. The balustrade to the stairs from top to bottom is of walnut, finished in a dead polish. The dining-room may be described first, it being nearest to the hall entrance, as will be seen by our plan. The scheme of decoration has a quiet and thoroughly artistic effect, though for a north aspect it might be thought rather too cold in coloring. The walls above the leather-paper dado, which is of a dark green color, are hung up to the frieze with tightly-strained tapestry fabric, rather Dutch in pattern, and of an admirable design. The grayish-blue groundwork is relieved with bold ornament in dark green in small masses, with gold threadings sparingly, but throughout evenly, used. The woodwork in this room is a dark bronzy green, and the ceiling is finished in a flatting of solid greenish-blue, in harmony with the rest. The frieze, about 15 ins. deep, is of embossed apple and vine foliage, in green-gold on a quiet pale blue ground, and the cornice, which is of good, massive proportions, has a greeny chrome for its final coat. The floor is stained a dark brown, and varnished. The mantel is of walnut, the firegrate being a hob stove, having the cheeks of the hobs filled with sunflower-scroll tiles, like the upper back and sides. A good, Talbert-like buffet, bearing the date of 1873, stands between the doors at the end of the room, and a fine portrait of Mr. Hunter, by J. Pettie, R.A., dated 1878, hangs at the side. An unsigned likeness, in oil, of Mr. Hunter's eldest child, graces an old gilt carved frame, of good Italian design, over the fireplace. The serving-door and kitchens are conveniently planned. The drawing-room is at the back of the house, and commands the nicely-wooded garden. It is a very interesting and richly furnished apartment, having a dado of sienna leather paper, with a warmer tone of the same color for the walls, on which are hung several large pieces of old needlework, in frames. The frieze is exceptionally rich and deserving of praise. It is embossed with thickly arranged foliage in conventional forms, finished in green gold. The cornice is deep in section, having a second frieze ornamented with incised plaster-work, which looks very well, and the whole of this part is colored a warm buff, the ceiling being in sky blue. The furniture is draped with an elegant and delicately designed patterned stuff in greenish blue and white, by Morris & Co., and the woodwork of the joinery is painted a lemon-cream white. The grand piano here in black is another instance which shows how difficult such a piece of furniture is to design. The most interesting object in this room has yet to be mentioned, namely, the Italian-like hooded fireplace. The upper part, which seems to be old, projects boldly into the room, and is of richly carved stone, having massively-treated consoles and delicately-moulded and carved pilasters, which, together, bring the horizontal hood some six feet six inches from the floor. Brass candelabra branch out on either angle, and the central recess of the upper part is filled with silvered glass, the soffit being in gold embossed leather. Three large old blue tiles of rare merit are set in the deep marble frieze immediately over the basket-grate fire opening, and the whole composition is very suitable and pleasing, though for a drawing-room, perhaps, unusual. We now arrive at the studio, which, of course, is the main room in the house, both on account of size and position, having a gallery arranged over the retiring-room at one corner, as shown. The woodwork seems rather dark for a studio, being painted a chocolate brown. The ceiling timbers are of oak, stained like walnut, of which latter material the gallery and staircase to it are made. The walls are painted in a brick-red flat, and the south windows are shut off by a large hanging of old tapestry. The sanctum already referred to is cut off by a curtain, the material of which forms a wall-hanging for the adjoining wall. Several interesting seascapes, by Mr. Colin Hunter's well-known hand, graced an easel or two, while studies in charcoal and oil stood on end and about the room on the occasion of our visit. In the glasshouse a fisher's basket with "sou'westers" and smocks indicated a recent foreground study from the life. Some good old bits of furniture are arranged round the studio, including a German cabinet in oak, nearly like one in the South Kensington Museum. The drawings in other particulars explain themselves.—*Building News.*

THE BERTHON DUPLEX DINGY.

The origin of these remarkable boats was a request made by Admiral Ryder, commander-in-chief at Portsmouth, to the Rev. E. L. Berthon, to devise, if possible, boats that could be carried by the torpedo launches, which, although the most dangerous craft in the world, are incapable of carrying any kind of ordinary boats—in fact, they can take absolutely nothing on deck, and the hatchways are only big enough for a man to squeeze through into the cabins—if they can be so called—only about 6 feet long and 3 feet 6 inches in height. To meet these peculiar circumstances Mr. Berthon constructed some of his collapsing boats in two equal parts, each 6 feet long, and which, when used singly, is a perfect boat with a square stern. By an instantaneous process the thwarts and bottom boards are taken out, and the half-boat collapsed will then pass through a hole 7 inches wide and 14 inches long. Some of these boats have gone through an exhaustive series of experiments with the torpedo fleet, and the official reports of them say they are simply perfect. They pull very fast, and are remarkably buoyant and very dry, especially when united only by the gunwale forelocks, as the bow then rises to every sea instead of pitching into it.

On June 4, prior to the torpedo experiments which were

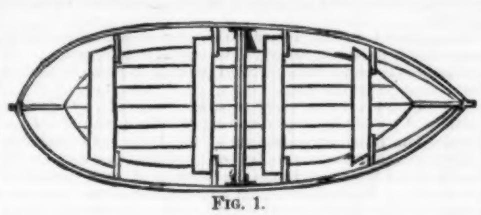


Fig. 1.

carried on that day, Admiral Ryder invited a large party of officers and civilians to see the action of these duplex boats at Spithead, where three torpedo boats were in readiness, the crews of which had never seen these boats before. Three of them were launched from the Sprightly and sent to the torpedo boats, with orders to shut them up and stow them below. This done, a signal was made by the admiral, "Out boats and come alongside." Such was the simplicity of their construction that by the light of nature the crews got out their boats in a very short time, the first being brought on deck, set up, connected, launched, and manned in one minute fifty seconds. The boats were then tried pulling and towing with six men in each, though the entire

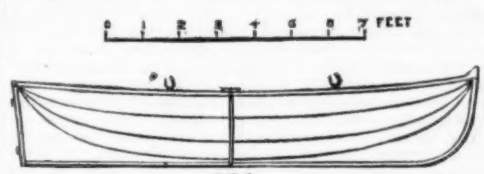


FIG. 2

crew of a second-class torpedo boat is only five. They rowed remarkably well and light, and when towed at sixteen knots did not bury their bows, but flew over the seas. It was amusing to see the half-boats disconnected with three men in each half and a race between them.

A large duplex for the first-class torpedo boats was also exhibited, and elicited general admiration by the elegance as well as other qualities she displayed. This boat is 15 ft. long, and 5 ft. wide, capable of carrying a dozen men. It should be borne in mind that all these boats are insubmergible; and being built in compartments an injury occurring to any part is of no consequence; but should one half be destroyed, for instance, by an enemy's shot, it can be instantaneously detached and escape made in the other. It is scarcely necessary to point out the great boon these little dingies will be to the owners of small yachts.

THE DUPLEX DINGY.

On coming alongside the halves are detached; and each weighing between 60 lb. and 70 lb., can be lifted on board by one man, then shut up into a few inches, and stowed out of the way. Or should it be desired to send a hand on shore a moderate distance, he can pitch half a boat overboard, and propel it by rowing, or sculling, for which a sculling notch is provided.

A considerable number of these new boats is now on its way to the torpedo fleet in Bantry Bay, and an order for them from the French Government is being executed at the Berthon Boat Company's works at Romsey.—*The Engineer.*

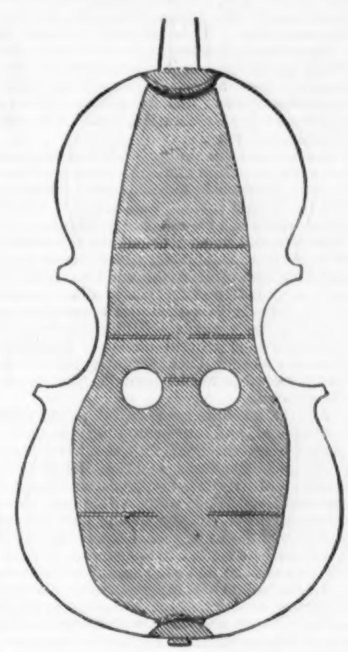
TELEPHONE WITH MAGNETIC SUPER-EXCITATION.

By M. Ader.

The new telephone is founded on the principle that if a slender blade of iron or steel is placed before the poles of a magnet, it is much more strongly acted upon if there is placed behind it a piece of soft iron than if this is not the case. Thus a greater sensibility is obtained by placing in front of the diaphragm of a common Bell's telephone, an iron disk pierced in its center, with a hole corresponding to the mouth of the apparatus.

IMPROVEMENTS IN VIOLINS.

My experiments resulted in the insertion of a central sound board, or diaphragm, midway between the back and the belly, attached firmly to the two end blocks, but not touching either the sides, belly, or back, so that it is free to vibrate from end to end. I give a drawing, drawn to a scale of one-fourth of an inch to an inch. The short line between the two holes shows the position of the bridge. Under each of the sound holes is a hole in the diaphragm one inch and a quarter in diameter. The object of these two holes is to allow the sound free circulation, one of them being also



required for the insertion of the sound post. The lower end of the diaphragm is also sloped off on each side until it meets the neck block in order further to promote the circulation of the sound. The diaphragm is perfectly flat, and about one-ninth of an inch thick throughout, made of the finest Swiss pine. In order to prevent a reedy tone by the vibration of the wood across the grain, six very slender cross-bars are glued across the diaphragm, just sufficient to tie the threads of the wood together. Mr. Furber, the violin maker who carried out my instructions, made a diaphragm for one of his violins of sycamore, without cross-bars, which answered equally well.

The diaphragm requires almost as much care in its manipulation as the belly; I had several made before I could find the right proportions.

The instrument I operated upon was an ordinary one; the tone, previous to alteration, was of a thin character, and unequal on different parts of the finger-board; whereas now it is fuller, of a finer quality, and remarkably equal throughout its whole compass.

Inequality of tone is a common fault in many violins, and I may, perhaps, venture a speculation why the diaphragm corrects it. Probably, where the vibration of the belly on some notes is deficient, the diaphragm, which operates under different conditions, comes to its aid.

I think there is much hope of improvement in what I will term the voicing of the violin by internal arrangements. I have made a number of experiments in this direction, some of them with good results, but I think the central diaphragm is the best I have yet tried.

I cannot say from one experiment which is best, the flat diaphragm or the vertical bar; the latter is more simple and easier of application: it gives improved power and tone with great equality throughout the compass. The harmonic sounds are remarkably clear and full. I think it probable that the bar would be improved by making the space be-

tween the outer and inner arcs of the circles only quarter of an inch. This would give greater elasticity and more room for the expansion of the sound, and I think would be strong enough, provided that the arcs of the outer circles should not be produced until they touch each other, but should be joined by a short curved line so as to leave at least half an inch of wood between the arcs of the circles. I have shown in two of the circles in the margin an illustration. There would thus be half an inch depth of wood along the whole bar.

I do not claim the origination of this contrivance; it is merely a modification of a central bar from block to block, for which a patent was, I believe, obtained about fifteen years ago, and which, Mr. Furber tells me, had an extensive run for some time. This bar was solid and stiff, and had for its object the tightening of the belly and preventing its being forced up by the longitudinal tension of the strings which sometimes does happen, especially to weak instruments. My modification of this bar gives a certain amount of elasticity which assists vibration, while it is sufficiently firm to strengthen the belly.

It seems strange that the violin should have remained unchanged for centuries, while almost all other musical instruments have been improved; modern makers usually follow the modes of the Italian school, but, however exactly they may gauge and measure a Stradiarius violin, and imitate its form and structure, the copy gives an inferior result. The art of violin making appears never to have been reduced to exact and scientific rules; even the eminent Italian makers scarcely made two instruments exactly alike in power and tone, and it is difficult to assign the reason for the great superiority of their instruments. I think, however, that one of their secrets was the careful choice of sonorous wood; and here I think is a hopeful field for investigation, in which the use of the microscope would, perhaps, give us an advantage over the ancients.

In the process of seasoning wood, the moist portions of the sap are dissipated, and on examining the wood with a powerful glass I have observed that the wood is traversed by minute cells and little ducts, and that the sides of these diminutive veins and arteries (so to speak) which run through the wood are varnished, as it were with a very thin film of the resinous or glutinous remains of the sap; the substance of the seasoned wood is, in fact, a series of minute air cells and pipes, and the form and arrangement of these differ much in different woods, and even in different parts of the same tree. I have not made any experiments to enable me to form an opinion on the relation between the microscopic appearance of the wood and its sonorous properties. The investigation of this subject, to any useful purpose, would involve long and laborious experiments and researches; but it seems probable that the Italian makers had some rough and ready rules to guide them in the choice of sonorous wood, for we find, as noticed in Mr. Hart's book on the violin, that much time and labor were employed by some of them in neatly joining small pieces of wood in their instruments, which evidently showed a desire to economize rare material.—*H. Walduck, in Journal of Society of Arts.*

[In the U. S. Patent of M. H. Collins, No. 129,653, dated July 23, 1872, and in patent of E. R. Mollenhauer, No. 218,761, dated August 19, 1879, is shown a sounding board which joins the sides of the violin, instead of being separated from them by a narrow space, as in the above cut. In M. H. Collins' patent for a banjo, No. 191,629, dated May 22, 1877, is a sounding board which touches no side, but is supported by an annulus or wide ring. A sounding board or "tongue" has also been arranged to project downward within a banjo or guitar, at an angle of about 45°.—Ed. S.A.]

THE ORIGIN OF FALLING MOTION.

By Charles Morris.

Why do bodies fall? The attraction of gravitation may be the active cause of their passing from a state of rest into a state of motion. But attraction of gravitation does not create this motion. Nor can we well imagine gravitative energy to be a mode of motion convertible into other modes. However great the effect produced, the force of gravitation remains unchanged. It is not transformed into motion of masses.

Whence, then, arises this motion? It is a form of energy, and must be derived from some diverse form of energy which it replaces. If, for instance, a body begins to fall to the earth from a position of rest, we can safely assert that the motion it displays pre-existed either in the earth, in the body, or in surrounding space. It was certainly not created for the occasion.

The theory of gravitation declares that the earth moves toward the falling body with a momentum equal to its own. If the body be supported above the earth, the support performs a double duty. It at once hinders the body from falling to the earth, and the earth from falling to the body. They compose parts of one rigid system. But if the support be removed the earth and the body at once become separate individuals, and they fall together, with equal momentums, until they again enter into rigid relations with each other.

The falling motion manifested by the descending body cannot, then, have been in some mysterious manner transferred to it from the earth; for the earth's own motion is equally to be accounted for, and in that case we would have to look to the body for its source. No active motion could appear in such an equal mutual transfer of motive vigor. We must, therefore, look elsewhere for the source of the motive energy displayed.

Nor can it well have been derived from contiguous space. It is too instantaneous in its appearance, and too regular in its increase, to arise from any such transfer of moving energy.

It must, therefore, have had its origin in the moving bodies themselves. Not, however, as an ideal "potential energy" converted into a real "actual energy;" but as a real motion, existing previously in some other form, and converted as needed into the form of mass motion.

Such motive energies exist as constituent forces of all matter. They present various modifications, and are named electrical, magnetic, chemical, cohesive, and temperate energies. These are partly modes of motion, partly modes of attraction: they are specialized manifestations of the general attractions and motions native to matter. The generalized form of attraction we possess in gravitative energy. The specialized forms are the organizing attractions of substances, such as cohesion, chemism, and possibly magnetism. It is the same with motions. The generalized form is the free movement of gas particles; the specialized forms are electricity, and heat as it exists in liquids and solids. But these two modes of motion are differently related to masses. Electricity is an organizing energy. It only manifests itself through change in the organization, or in the relations of bodies. Its only ready transformation is into heat.

Heat is a disrupting energy. It is the individual energy of the separate particles, and has nothing to do with the organization of molecules into masses; yet it is a generalized condition of motion only as it exists in gases. In liquids and solids it appears to be partly specialized; most probably becoming some form of rotation in liquids and of vibration in solids.

Heat force is neither concerned in the organization of the mass, nor is it closely related to the particle containing it. It is capable of ready transfer from particle to particle, and of ready change in direction.

We may look upon every separate molecule or distinct particle of a solid body as dwelling within a nest of attractions. The fixed organization of the body most probably causes these attractions to become definite in direction, so that it is not improbable that the motion of each particle is confined to a fixed center upon which these attractions converge, through which center it must vibrate, or around which it must rotate.

But the forces acting upon the particle are not alone the attractive energies and the repulsive impacts of contiguous particles. The attractive or gravitative energy of the earth is also a powerful factor in the result. This energy must influence the direction in which the particles move. It is, therefore, one of the various active forces to which this direction of motion must conform.

And gravitative energy is constant in vigor and direction. It does not vary as the forces of the surrounding particles may do. Thus every vibration or other movement of the particle has a vertical component, in response to gravitation, which must exercise a constant and unvarying influence upon the result.

Every particle, in fact, is incessantly falling. What we call a position of rest is really a position of constantly-arrested fall. If the surrounding attractions tend to force the particle towards a fixed point in space, the attraction of gravity tends to force it below the point. Thus it never moves to the exact point required by its contiguous attractions, but to a point nearer the earth, which forms a center of all its attractions, that of gravitation included.

The distance between these two points is the distance to which the particle falls during every vibration. It is arrested at this point by the surrounding attractions, the real ultimate arresting force being the repelling impact of the particles of the supporting substance.

Every downward movement of the particle is thus aided by gravitative attraction. Every upward movement is retarded. These invigorated downstrokes become themselves an element in the problem; they add, by their impacting force, to the descending energy of the particles below them. Therefore the lower plane of particles manifests the combined gravitative energy of all the particles of the mass. This is what we call weight, this energy of impact, produced by gravity, of the particles of every substance upon its support. It constitutes an incessant rain of down-beating particles: they strike downwards with a vigor depending, primarily, upon their own response to gravity; secondarily, upon the gravitative pressure of the particles above them. The support must be strong enough to bear its load, or it will inevitably give way under this fierce and incessant rain. If the support be removed, what follows? The forces surrounding the particle remain the same. It descends in response to the gravitative component of these forces. This descent is not resisted by the surrounding energies, since all the particles descend at the same time from the same cause. The only real resistance to fall is the upward compact of particles occupying the space through which the fall must take place. If this resistance be removed or sufficiently decreased every particle of the mass must simultaneously descend in response to gravity, and the whole mass change its position.

Thus the heat movements of the particles are made to conform in direction by the attraction of the earth, this conformity constituting a movement of the mass as a whole. And this is a regularly increasing movement. As the mass moves its motion constitutes an energy. The motion caused in each instant by gravitation remains the same. But it has a separate effect in every separate instant, and these effects are persistent and constantly accumulate, producing a regularly increasing motion of descent.

Falling motion, then, appears to be a partial specialization of the heat movements of the particles. These movements are made to conform in direction to a certain degree, under the influence of a fixed and persistent attraction. This descent is continuous, whether it be resisted or not. If resisted it cannot accumulate. Each momentary fall makes itself felt as weight by the resisting body; but these momentary falls are each obliterated by a reverse impact, and cannot be added together, constituting an increasing energy of fall. Only when the resistance is removed, and the particles are no longer driven back by impact, does the falling energy manifest itself in a downward movement of the mass.

Thus, when a body falls, part of its heat motion has been transformed, and has become a motion of the mass as a whole. The generalized motion of heat has become partly specialized into motion of the mass. This is readily transformable again into heat; but it can only be so transformed by resistance. It is persistent as mass motion until some resisting energy overcomes it, when it again becomes heat.

And from this fact two conclusions necessarily arise. The first is, that a body whose mass motion is resisted must display an increase of temperature. The conformity in the motion of the particles is broken; they again move individually instead of collectively. Temperature effects appear in consequence.

The other conclusion is, that a body yielding to gravitation, in increasing its mass motion, must decrease in temperature. Its temperature is being converted into another form of force, and cannot continue to display its usual effects. The body grows colder in every direction except that of its mass motion, the movements of the particles being specialized in this direction, and their impacting force partly decreased in all other directions.

The heat thus lost, as heat, is probably regained from the radiations of the matter through which the body moves, so that its sum of forces is increased in consequence of a special transformation of a portion of them.

Where the motion of the body is decreased or increased by gravitation, without radiation of heat from other sources, certain interesting and perhaps important effects must ensue. If a mass be driven upward against gravitation its particles must continue to fall. The downstroke of their vertical component of motion, as caused by gravitation, is constantly more vigorous than the upstroke. The fall of the body is simply masked by its upward motion, and accumulates in the same manner as if the mass was descending. Thus the upward motion is more and more rapidly obliterated, and soon ceases to exist, the mass becoming momentarily at rest. What has become of the mass motion? Evidently there has been a simple change in the character of the motion of the particles. Instead of moving upward more rapidly than they descended, they now move upward and downward with the same vigor. The special mass motion has fallen back into the body, and has become vibratory movement of its particles. It has, in fact, become temperature, and the sum of temperature energy has increased through this loss of mass motion.

If now we apply this idea to the movement of the planetary bodies, some interesting deductions may be made. In the case of a comet moving from the sun we have an exact counterpart of that of a body thrown upward against gravity. The particles of the comet continue to fall toward the sun. These slight falls are masked in the mass motion of the comet, but they slowly consume this motion. They constantly accumulate, precisely as if the reverse motion did not exist. The comet is thus at once moving outward from the sun and falling inward to the sun, and its real motion is the difference between these opposite energies. Its mass motion is, in short, falling back into its substance, and becoming vibratory motion. Eventually the fall increases in vigor until it equals the outward motion of the mass. At this point the comet ceases to remove from the sun. The outward and inward movement of its particles have become equal; the vertical component of their motion through space has become converted into a vibration about a fixed point in space. It has, in fact, become heat motion.

Thus the strange fact displays itself of a rapidly-increasing temperature in the comet, as a necessary consequence of its movement outward from the sun. In its return to the sun the opposite effect occurs. Its vibratory motion is gradually transformed into mass motion. Every new increment of mass motion thus gained is at the expense of the heat vibration, and the temperature necessarily decreases in consequence.

This effect is, of course, masked in its increased reception of radiant heat in approaching, and its rapid radiation into space while leaving the sun. It is in this like a falling body whose lost temperature is regained from the radiations of surrounding matter.

A precisely similar effect must occur in the case of every planet which has an elliptical orbit. The earth, for instance, after passing its perihelion point, begins to move outward from the sun against gravitation; but the fall of its particles toward the sun at once tends to consume this outward movement. The earth possesses really three movements, from whose composition its orbital movements results. One of these is a movement at a tangent to the radius of its orbit. This is resisted by a falling motion toward the sun in response to gravitation. These two energies are exactly balanced; neither can accumulate at the expense of the other, and they result in a circular orbit. But there is a third motion, a vertical vibration in the line of the radius, a vibration of some three millions of miles in extent, each phase of which occupies six months. This vibratory movement has its full effect upon the resultant motion of the earth, changing its orbit from a circle into an ellipse.

But the vertical vibration is resisted by gravitation in its outward phase, and aided in its inward phase. The result is that a portion of the motive energy of the earth is consumed, by the resistance of solar gravitation, during its outward movement. This lost mass motion must fall back into the earth and become a vibration of particles, constituting an increase of temperature. Its inward movement is, on the contrary, aided by gravitation. The mass motion increases at the expense of the temperature energy.

The loss of mass motion in the earth, from this cause, between perihelion and aphelion, is about 1¼ miles, or 6,600 feet, per second. It will consequently not be difficult to obtain an idea of the amount of variation in temperature from this cause. For we know that a mass of water, when arrested after a fall of 772 feet, gains 1° F. in temperature from a conversion of its mass motion into heat vibration. Now a fall of 772 feet yields a final velocity of about 220 feet per second. If the loss of this velocity yields water a temperature of 1°, the loss of 6,600 feet per second of velocity by the earth should yield it an increased temperature of 30° F., supposing its mean specific heat to equal that of water. If the specific heat equaled that of iron the increased temperature would be about 270°, and if equal to mercury it would be 900°.

We have here a very marked result, but one that is not strikingly evident, from the fact that this lost motion is not an instantaneous arrest, but a gradual arrest extending over six months. The true result, then, is daily increase in temperature, for every particle of water in the earth of one-sixth of a degree, of 1½° for every particle of iron, of 5 per cent. for every particle of mercury, and a like result for every other substance in accordance with its specific heat. During the return movement of the earth, from aphelion to perihelion, the opposite effect results. Its mass motion increases, at the expense of its temperature, to an equal degree.

This variation in temperature cannot have any very evident effect at the surface of the earth, where it is lost in the much greater effect of the solar radiations. But in the earth's interior it may possibly produce important results. The variation in the earth's internal temperature, through loss by conduction, is exceedingly minute. But we have here a source of a considerable increase during six months of the year, and a like decrease during the succeeding six months.

These daily variations cannot be lost by radiation, but must accumulate, so that the temperature of internal water must vary 30° yearly, of mercury 900°, and of other substances in like manner. Although we do not know what results are likely to arise from such an annual variation in temperature, yet it is very possible that these results may be of an important character.

In the case of a planet of short period and great simplicity of orbit, such as we have in the planet Mercury, the effects resulting from this cause must be much greater than in the earth. It, indeed, must produce a marked effect on the surface temperature of Mercury, and an annual variation sufficient to partly neutralize the variations in the amount of solar heat upon this planet.

An interesting conclusion from the hypothesis here advanced is in regard to the simple and natural method in which one mode of motion becomes converted into another. The change from heat vibration into mass motion needs no special machinery and no difficult transfer of energy. Motion seems to be constantly at the command of attraction. The least definite pull in any fixed direction, if unresisted by opposing energy, at once converts heat motion into mass

motion. This latter, in its turn, is persistent until resisted, when it immediately becomes converted into the independent movement of particles.

The change from electricity to heat is probably as simple in its nature. The impelling cause, in all cases, seems to be some variation in attractive conditions, to which the moving particles instantly respond, their modes of motion becoming special results of the attraction.

And as there is but one motion, so there is, in all probability, but one attraction. Gravitation, chemism, and magnetism are probably modes of attraction, as heat, electricity, and mass movement are modes of motion. The different forms which these assume very likely result from the different relations of position assumed by the particles of matter. It is probable, also, that molecules have special relations of position between their constituent parts, and that their outward attractions become specialized in consequence. The relations of position between particles or masses at a distance from each other are general, and their attraction takes the generalized form of gravitation. The relations of position between particles in close contiguity are special, and their attractions become specialized. The modes of motion resulting are in direct response to the mode of attraction, and are readily convertible into each other at every variation in attraction.

As the generalized mode of attraction is gravitation, so the generalized mode of motion is the movement of the gas particle. This is so vigorous in its action as to resist the attracting energies of contiguous particles. Its motion is, therefore, influenced in vigor only through impact, and in direction only through impact and gravitative attraction. It is constantly falling in response to gravity, and constantly rebounding in response to impact. Wherever the resisting impacts are reduced in quantity the gas particles move in greater number, this movement constituting a wind, which increases in force as the resistance to the individual movements of the particles decreases in quantity.

Give the particles an opportunity to strike together with special ease in one direction, and a wind necessarily ensues. A fall, in response to gravitation, only ensues when the particles near the surface are separated by increased temperature, or through some other cause so that their resistance to impact is decreased.

Attraction of gravitation, therefore, has no influence in increasing or decreasing the motive energy of matter. Its only influence is directive. It controls the direction of the motions of particles, so far as its control is not resisted by some other controlling attraction. The direction and mode of motion of the particle, at any instant, is a resultant of all the attractive and repulsive forces acting upon it at that instant, gravitation being simply a constant component of these forces.

The vigor of motion possessed by the particle can vary only in two ways. One of these is by impact, in which the energies of the two impacting particles may become changed, their sum remaining unchanged. The other is by the resistance of attraction. Here the particle loses motion, but gives its lost motion to the attracting particles, which it drags into swifter speed.

Motion cannot die nor be born. It can only be transferred in amount and changed in direction.—*Journal of Science.*

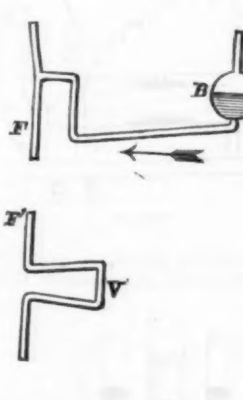
ON AN IMPROVEMENT IN THE SPRENGEL PUMP.

By Professor O. N. Rood, of Columbia College.

In this notice I propose to indicate very briefly the nature of an improvement that I have lately made in the form of the Sprengel pump, which enables the experimenter easily to obtain a vacuum as high as $\frac{1}{50000000}$ or $\frac{1}{100000000}$, reserving the details of manipulation, etc., for more extended notice hereafter.

(1.) The improvement consists, first, in an arrangement by means of which the mercury, instead of being at once introduced into the pump, passes beforehand through an exhausted bulb, B, thus freeing itself in great measure from air and moisture. It afterwards passes through a nearly horizontal tube, finally reaching the fall tube, F, as shown in the diagram.

(2.) The second part consists of what amounts to an almost theoretically perfect fluid valve, which prevents the



air that has passed out of the fall tube from returning into it; this is accomplished by merely bending the fall tube as indicated at V. As for the rest, the pump is contrived so as to be free from stop cocks and grease.

By inclining the pump somewhat, the bulb can be exhausted once for all, as matters can easily be arranged so that when the atmosphere is allowed to enter the pump, the exhaustion of the bulb remains intact.

The action of this pump is very rapid, two hours or less sufficing to reduce the vacuum from $\frac{1}{20000}$ to $\frac{1}{10000000}$, the total capacity of the pump being 100 cubic centimeters.

The exhaustion in these experiments was always accomplished by mechanical, not by chemical means; chemical substances being introduced solely for the purpose of drying the air. In the total absence of all such substances I have obtained a vacuum as high as $\frac{1}{30000000}$. The means of measuring these vacua and other details will be given as soon as a set of experiments that are being made on the caliber of the fall tube is finished.—*Am. Jour. of Science.*

NAVIGATION OF THE AIR—FLIGHTY ASPIRATIONS.

By Fred. W. Brearey, Hon. Sec. to the A.S.G.B.

Adventitious circumstances sometimes place men at the helm, who, being ignorant of all duties save one, assume the possession of all, upon the faith of having steered wisely in times past. So long as he retains the helm he will probably retain the confidence of his passengers; but let him act upon his assumption of knowledge in another sphere, and his ignorance may entail contempt. The human barnacles which fastened themselves upon the ship called Progress—sometimes the vehicle for the conveyance of such passengers as gas, lightning, steam on rail, etc.—have, it must be acknowledged, been nearly rubbed off, so rapidly has the Progress rushed through the waves of success.

So the helmsman has learned at last to stick to his tiller and observe with respect, among other vessels, one freighted with such a cargo even as aerial navigation. I have preserved an old barnacle. It will be found in the *Quarterly Review* for the year 1819. It was stuck to a ship that was being freighted with ideas for a railway:

"We are not partisans of the fantastic projects relative to established institutions, and we cannot but laugh at an idea so impracticable as that of a road of iron upon which travel may be conducted by steam. Can anything be more utterly absurd or more laughable than a steam-propelled wagon, moving twice as fast as our mail coaches? It is much more possible to travel from Woolwich to the Arsenal by the aid of a Congreve rocket."

Don't you see that this barnacle was stuck upon a passing ship by the helmsman who quitted his tiller, and thereby manifested his intense ignorance?

This greatly dead and much-stained editor—as we may call him—may now be pictured laughing uproariously in presence of an enlightened audience, who look upon him with grave pity that so intelligent a man should be making such a humiliating exhibition of himself.

I am afraid that my remarks are not very respectful toward those editorial commentators who are apt to limit the aspirations of science to their own conception of what is possible. What, then, can be said of a barnacle stuck on with the authority of an acknowledged scientist such as Dr. Lardner, who, in his "Cyclopedia" of the edition of the year 1836, under the head of Hydrostatics—which is too lengthy here to quote in full—gives his reasons for asserting the impracticability of accomplishing, with any advantage, the then discussed employment of steam for ocean-going ships? He says: "But we have here supposed that the same means may be resorted to for propelling boats on a canal, and carriages on a railroad. It does not appear hitherto that this is practicable." He says again: "The friction of a carriage on a railroad moving 60 miles an hour would not be greater than if it moved but one mile an hour (!); while the resistance on a river or canal, were such a motion possible, would be multiplied 3,600 times." By friction he means resistance, because in another place he says: "The resistance on the road, instead of increasing, as in the canal, in a faster proportion than the velocity, does not increase at all." So that we have it, upon the dictum of Dr. Lardner, that a wind blowing upon a surface at 60 miles an hour—the conditions are only reversed—produces no greater pressure than if it were blowing with a velocity of but one mile an hour. In each assertion of the rate of resistance Dr. Lardner was intensely wrong.*

The late Sir Wm. Fairbairn became a member of the Council of the Aeronautical Society of Great Britain. Now the supporters of this society entertain two diverse opinions, but both parties aim at macadamizing the aerial highway so as to make it subserve the purposes of transit. To the ordinary observer there is only one way. It is that which has been brought hitherto under his observation. Sir William was a balloonist. The balloon is a fact beyond dispute, so that all we have got to do, says he, is to propel it. It is given only to the man who has made its propulsion a study, and has been left gazing regretfully after the money which he has expended in his vain attempts after utility, to estimate rightly the opinions of that section which may be designated by the title "Gravitites," in opposition to that of "Levitites." The Gravitites contend that the object of aerial transit will be effected by opposing the resistance of the air to the action of gravity; that while gravity is a constant force the resistance of the air is under control, so that it can be made subservient to the support of any weight, the surface of which is sufficiently extended, and propelled with the requisite velocity. For instance, a sheet of stiff cardboard can be propelled horizontally by means of a finger loosely placed at the rear edge. By increasing the velocity beyond the necessary requirement, the cardboard or any plane surface will depart from the horizontal in an upward direction, in obedience to the increased resistance of the air; and the rate of velocity being increased, it will turn over toward the hand.

It is the desire of some workers to obtain support in the air by extending the area of such surface and propelling by screws; upon a small scale this has been proved practicable. Models of dimensions and weight capable of being launched from the hand are very effective; but when those of a larger size which cannot be thus manipulated are attempted to be put to practical use, a preliminary run upon the ground is necessary, and hitherto the velocity under those conditions—being retarded by friction, although upon wheels—has not been attainable. This velocity is an absolute condition, so as to enable the apparatus to meet with that atmospheric resistance which would force it to leave the ground and continue its flight in the air. Certainly no rails have yet been laid down with the object of reducing friction, but the aid of an incline has been enlisted without effect. No experiment worthy of the object sought to be attained has yet been attempted by any one holding the opinion that eventual success lies in this direction.

My idea of a satisfactory trial would be the employment of great power, large and strong surface, and as frictionless a road as could be devised; for instance, upon a straight line of rail.

The interest which is attached to many scientific subjects is, however, absent in this, so far as respects the public, and among scientific men generally. So little understood are the principles upon which the hope of flight is founded that it is well known that if a discussion is started in any scientific periodical there are scarcely any instructed minds to follow it up, and the subject dies away almost from its birth, eliciting nothing but worn-out ideas, and always drawing out the suggestion that gas should be used to take off the dead weight. This suggestion is as absurd as the converse one of using an aerial machine to propel a balloon.

Those who saw poor De Groof when he left Cremorne Gardens, in the hour of his death, dangling from the balloon in his comparatively fragile framework, will call to mind the diminutive appearance of the apparatus compared with the bulk of the balloon. To take off the dead weight would require as large a balloon as usual, but still of such a capacity as would dwarf any attached apparatus, and it is quite certain that if the apparatus had any power over the balloon it would not be exerted to propel it, but to drag it at the stern.

So the earnest workers and students are a very small minority. For want of guidance and the dissemination of fundamental facts, the result of experiment, many have been working in the dark, and, doubtless, encouraged by the general ignorance, many pompous announcements have been made during the present century which have raised false hopes, and the reaction has had a most injurious effect upon the study of aerology with a view to the sustentation of heavy bodies. The fact is that a triumph over the difficulties of aerial transport presents to the mind which can grasp the future such an Aladdin-lamp romance that the individual is inclined at once to self-depreciation, and to say that "not for me is such a fate in store."

Some such effect has operated to produce apathy as is recorded by Stewart in his "History of the Early Days of the Steam Engine," as follows: "Every miscarriage thus added to the obstacles which at all times impeded the introduction of improvements, and the abortive attempts of ignorant and designing men were urged as reasons for disregarding the inventions of more honorable and meritorious individuals."

I cannot leave the subject of plane propulsion without reference to a late attempt by Mr. Linfield, of Winchester, whose design was suspended from the skylight of the large room at the Society of Arts, at a general meeting of the Aeronautical Society of Great Britain, in 1879. This formidable-looking affair was 40 feet long by 18 feet wide, attached to a framework upon four wheels, the whole rising about 15 feet; 300 feet of canvas was stretched upon an upper frame, and below this and upon the wheel-supported platform the operator stood with his feet upon treadles, by which he worked two fan blades, 9 ft. 6 in. × 2 ft. 9 in., in front of the apparatus. By this he obtained about seventy-five revolutions a minute, which enabled him, upon a macadamized road, to attain a speed of about 12 miles an hour—totally insufficient, however, to enable him to obtain any fulcrum upon the air, for its weight including himself was 304 lb. Nor was a subsequent attempt down an incline, by which he gained a speed of about 20 miles an hour, any more suggestive of aerial support.

In order to give some idea of the solid support which a body of air is calculated to afford to any surface passing over it in a horizontal direction, and which can be increased or diminished according to the angle in which it is propelled, I will quote some suggestive remarks of Mr. Glaisher, made at one of the Aeronautical Society's meetings, upon the subject of the captive balloon then lately exhibited at Chelsea by Mr. Giffard: "That balloon has spoken to me trumpet-tongued. All my life I have been accustomed to weigh the air by grains. In winter I find the cubic foot to be about 5.0 grains, and in summer 20 or 30 grains less. When we took grains we thought the air light. When I saw the other day that the balloon would lift 16 tons or more, and consequently that the weight of air displaced by the balloon must be of greater weight, there must, I think, be something for members of the society to work upon. When you see that balloon as a small ball only, yet know that air to so many tons weight was displaced by it, surely it held out the hope that some means would be found to solve the problem of aerial navigation."

The method to be adopted to attack this thin though weighty medium, so as to wrest from it the means of support in safety, and the mode of propulsion, is of course the subject of discussion and of some difference of opinion among experimenters.

Sir William Fairbairn stuck another barnacle on the good ship Progress when he stated as his opinion, in a paper read at Stafford House, that "Man was never meant to fly; that if the Almighty had intended him to do so He would have given him wings, and that the unalterable laws of nature were against us." Now it is still a disputed point whether a man possesses the power to manipulate anything in the nature of wings so as to afford him support and propulsion. The few experiments which have been made in this direction are not sufficiently authenticated for us to deduce any reliable data from them.

Without wishing to dogmatize and especially without laughing like the writer in the *Quarterly Review* before referred to, I hold, with the Duke of Argyll, the opinion expressed in his own words when occupying the chair at one of our meetings: "I think it quite certain that if the air is ever to be navigated it will not be by individual men flying; but it is quite possible vessels may be invented which will carry a number of men, and the motive force of which will not be muscular action." I limit the application of these words to the action of wings by man's muscular efforts. I wish I could think that the late Sir Wm. Fairbairn had made the same reservation.

The laws of nature, fortunately for us, are unalterable, and as often as they have been questioned as to their adaptability for aerial support they have returned a favorable reply.

It may be conceded that a properly constructed plane surface, propelled against the air, will meet with sufficient resistance to enable its course to be deflected upward at an incline obedient to the angle at which such plane is driven, and sooner or later according to velocity.

An experiment is recorded in one of our annual reports which was made by M. de Louvrie. To a little carriage he fixed a thin plane surface the angle of which he could alter at will. Placing this machine upon a level spot, he drew it along horizontally by means of a cord which was fastened to a dynamometer, and increased the speed until the machine left the ground, suspended by the pressure of the air on the plane.

In a large machine such as Mr. Linfield's, where the balance cannot be adjusted with that facility which is readily attained with models launched from the hand, the difficulty will commence with the first tendency to rise. Supposing him to be unable to attain sufficient velocity with a new arrangement which he is constructing, his next step, I presume, would be to attach it to an engine on a railway, and repeat upon the largest scale the experiment just recorded. Now, in such cases the laws of nature are greatly in our favor, as proved by some experiments initiated by the society to which I have the honor to act as honorary secretary. It remains as a condition—hitherto unfulfilled—that man must attain to perfection in his appliances before he can

* A train of carriages and engine weighing 300 tons would meet with a resistance of 3,870 lb. at 10 miles an hour, which would be increased to 12,470 pounds at 60 miles an hour, irrespective of its advance against the air.

evoke the utmost effect which is capable of being wrested from nature in her passive mood.

The experiments consisted in forcing a blast of air against various extents of surface presented to it at varying angles, in order to ascertain not only the force with which they would be driven back, but the weights which they would be able to lift by the air passing beneath the under surface of the various inclines.

Like the sheet of stiff cardboard propelled by the slight pressure of the finger against the posterior edge, supported by the pressure of the air underneath, it was required to know what that pressure was which tended to lift or tilt it up, because that knowledge would enable us to ascertain what weight it would bear to keep it from so tilting up, and also what amount of pressure forward represented by the finger would be required to propel it. And this is one of the results discovered, viz., that propelled against still air, at an angle of 15°, and at the rate of 25 miles an hour, a square foot of stiff plane surface—in this case it was steel plate—will support a weight of 1⅓ lb., while the resistance to its forward motion is only 5¼ ounces; so that it requires but little more than 5¼ ounces to propel it.

I must say that, if we apply this calculation—the result of accurate experiment—to Mr. Linfield's arrangement of area, we do so to its great disadvantage, because he never contemplated advancing against the air at such an angle as 15°; and unfortunately,, by some extraordinary oversight, the instrument employed in the experiment, and made expressly with that object, was unable to record any angle less than 15°.

Those very angles which most concern aerial experimenters were left out of the question. It may, however, readily be conceived that at less angles the resistance to the forward motion is less, consequently the power required to propel is less, except that greater velocity is required to keep the same weight in suspension.

But we will take the calculations at 25 miles an hour and 15°, and 300 square feet of plane surface. At that velocity a rigid plane surface would support, at the least, 450 lb.—in reality much more than that, because the supporting effect of a plane increases in some yet undetermined ratio for each additional square foot. This, however, is not a rigid surface, and therefore some element of uncertainty exists.

However, it appears to be necessary for success to be able to propel such a surface at the rate of 25 miles an hour. We have it reported that down an incline Mr. Linfield succeeded in obtaining 20 miles an hour; but inasmuch as upon the level ground he did not travel more than 12 miles an hour, with the greatest number of revolutions which it was possible for him to impart by his muscular efforts to the screw propeller, it is evident that the excess down the incline was due only to gravity. The additional air pressure must have had the same effect upon his screw blades as the wind produces upon the sails of a windmill, thereby accelerating the speed of the screw without producing an increase of propulsive force, because the air would pass with a greater velocity than that at which the screw was working, rendering it impossible for him to keep his feet upon the treadles. The aid of an engine and railway would therefore be no assistance to any one trying a similar experiment. It is, I think, conclusive that man has not sufficient power to revolve a screw capable of giving him the necessary speed to leave the ground. Whether if he left the ground and traveled only in the frictionless air, he would, under such conditions, possess the power to continue his flight remains undetermined. He could only be introduced into such a position for determining the truth by first being flown as a kite without any screw action, and then, having attained that position, he could set to work with his screw. The question of balance is a most important one for consideration. I have known repeated attempts to effect the flight of models entirely fail for want of a proper adjustment of weight. The attainment of that necessary condition for success would be not the least of the difficulties to be encountered by the plane propeller, where he himself is the adjustable weight, yet confined to his work at the treadle.

The conclusion is, I think, inevitable that another and more powerful motor than that of a man is necessary to get the initial velocity. I think that it will have occurred to the reader of this paper that the screw blades themselves are a source of hindrance to progression; that while all else lies along the plane of progression, the screw blades offer a direct opposition to the air the moment that the operator travels by any extraneous aid *faster than he can revolve the screw.*

Here is unmistakably shown the enormous advantage of the wing movement, where the means both of support and propulsion lie in the plane of progression and only edge resistance is offered to the air. The notion of wings, however, is nearly always ridiculed. Somehow we are inclined to contemplate them as we are accustomed to see them portrayed upon the backs of angels, where the muscular development is singularly wanting; and looking at a full-grown angel as depicted by some of our artists, one does really doubt his ability to fly.

Had Sir Wm. Fairbairn such an imbecile in his mind? Possibly, as those who entertain such flighty aspirations are supposed to be devoid of common sense, it might be supposed that we relied upon these angelic prototypes as our authority. Well, I will at once disabuse their minds. We object to them strongly, not only because the proportions and malformation are unworthy of the object, but because they haven't any tails!

That, however, which painfully strikes me as wanting in any plane surface used merely as a fixed plane is the apparent absence of stability. I should not care to trust myself to the possible vagaries of a screw-propelled plane. It seems to me to be a structure without any life in it, unable, as it were, to help itself. It represents the fag end of a bird's flight when he rests from his labors, and, by the aid of the impetus gained, continues his journey with motionless wings extended as a plane.

This plane he can also use as a propeller; and therein consists one of the grand instances of superiority over any other mode of aerial transit. But it is the manner of its use which demands from us the acknowledgment of its great advantage.

The action of a bird's wings is exerted in a space of *three dimensions*, measured by the length of the wings from tip to tip—the arc of vibration of wings—and the length of the body, to which might perhaps be added the effect, both in front and rear, of a reaction arising from their attack upon the air. The stability which by this process is attained, within the knowledge of every one, exists in spite of the fact that the wings are moved up and down, although alternately above and below the center of gravity of the bird, and although the head and the tail are really acting as the scales of a balance of which the wings are the center. Those who have watched the flight of wild ducks must have been struck with the peculiar contour which they present. The wings appear to be the cross center of a cylindrical shaft. The dimensions of a tame duck which I have just measured are: extreme length from toe to beak, 29¾ inches; from beak to root of wing, 14 inches; stretch of wing from tip to tip, 32 inches; so that the wings are only 2¼ inches longer than the whole body, which in flight would present this shape:

In all probability this bird flies in a stratum of air—taking 1 foot as the extent of vibration of wing—more than 6 cubic feet of which is put into a state of commotion in every sense conducive to its support and balance.

Whatever may be thought, therefore, as to the folly of obtaining flight by wing vibration, nevertheless it is to that or to some application of the principle that we must come in our attempt to make flight serviceable for man.

It is very doubtful whether man has the power necessary for the manipulation of wings of dimensions and strength sufficient to afford him support, but I think it very possible and probable that he may construct an apparatus with surface sufficiently large to sustain him and the additional weight of a motor powerful enough to attack the air so as to obtain support and proportions from it.

We know that the long winged bird, such as an albatross, has a very flexible wing which hangs quite droopingly from the body, and which, being vibrated, produces a wave action from the root of the wing to the tip.

It is not the lot of many who will read this paper to shake carpets, but to all it will be understood how the wave of air compressed in the downward shake is propelled underneath, so as to throw the carpet into waves, and how—if with sufficient power—those waves are bound to escape at the opposite side; and if with rapidity of wave action, how the carpet may be made to hover above the floor without contact. Suppose that we can communicate such an undulation to a fabric free to vibrate in the air, then its progress would be exactly opposite to the direction of the wave, and it would entirely depend upon the power that we could employ to enable us to determine what weight of fabric could be thus thrown into wave action and thereby supported and propelled; or, in other words, how light a fabric could be used and what additional weight could be substituted. Had Mr. Linfield's arrangement of 300 square feet of fabric been provided with the power to impart this wave action, a very different result might have been recorded.

All the experiments which I have made in this direction, with models set free in the air, have pointed to probable success when manufactured upon a scale of utility. This means the capability of sustaining and propelling 1 lb. of weight for every square foot of surface, and this capacity ought to be sufficient to provide for the sustentation of the necessary motive-power. The action of such an apparatus may be thus described: A kite-like structure, the two arms of which are not fixed liked the kite, but are free to move, in the manner of the wings of a bird, with a sweep of perhaps 6 feet; width of such arms from tip to tip, 20 feet, the fabric attached to the arms and extended backward some 30 feet affording, with its triangular shape, above 300 square feet; from thence a tail, capable of elevation or depression—the whole capable, by the aid of steam, of acting upon a stratum of air of perhaps 3,000 cubic feet.

It may be disputed—as it has been—that a fabric shaken as described has any propelling tendency, because, say the objectors, "If you leave your hold it will recede from you." My prescription would be, "Keep it well shaken." But although I have advanced this illustration of the carpet, the cases are not exactly parallel. By the peculiar vibration given to my arrangement a double wave action is imparted—that is, along the wing arms, and obliquely throughout the fabric from front to back—so that the air is propelled laterally, the fabric being attached to the body or shaft which runs down the center like the backbone of a kite.

For all answer the propelling power of such an arrangement has been proved to be effective. The sustaining property is not disputed. Moreover, owing to the "bellying" of a large surface, from the great resistance offered by the air, a gradual and safe descent is insured in the direction of advance, upon cessation of the motive-power.

This is my "Flighty Aspiration," irrespective of details, and I contemplate its construction.—*Journal of Science.*

CONSTITUTION OF NEBULÆ.

CH. FIEVEY has made the spectral rays of hydrogen and of nitrogen the subject of a special careful investigation. By attaching to the spectroscope a contrivance which enables him to regulate at will the quantity of light received, he observed that the spectrum of hydrogen was modified and simplified in proportion as the brilliancy diminished. The H line first disappeared, then C, and finally only F was left. It is well to remember that the F line is the only one of the hydrogen lines which has been observed, in a large number of nebulæ that have been examined by the spectroscope. The spectrum of nitrogen gave results similar to that of hydrogen. It is, therefore, not strange that we should meet, in nebulous spectra, only the rays which are most persistent in diminished light. Such rays may suffice to establish the presence of the body to which they belong, and the disappearance of the others may be explained by their extinction in traversing the intervening spaces.—*Bull. de l'Acad. Belg.*

MAGNETIC AND DIAMAGNETIC ELEMENTS.

THE magnetic elements are N, O, Fe, Ni, Co, Mn, Pt, Os, Pd, Ir, Rh, Cr, Ti, Ce, C, K, and U. The diamagnetic are H, Na, Cu, Ag, Au, Hg, Zn, Cd, Pb, Sn, P, As, Sb, Bi, S, Se, Cl, Br, I, Tl, Si. Carnelly has observed that all the elements which are found in the even series, in Mendelejeff's classification, are magnetic, while those of the odd series are diamagnetic. This result furnishes new and interesting evidence of the shrewdness of the investigators who are endeavoring to trace all chemical and physical phenomena to the action of primitive laws of motion.—*Ber. d. D. Chem. Gesell.*

ELECTRO-CAPILLARITY.

M. DEBRUN, *Preparateur* to the Faculty of Bordeaux, has recently exhibited at the Sorbonne a modification of the remarkable capillary electrometer invented by M. Lippmann. This modification was not made for the purpose of improving it, but merely for making it a less fragile and costly instrument. The apparatus is composed of a capillary tube 1 millimeter in diameter and 30 centimeters long, several times bent, and the part A B (Fig. 5) of which, 10 centimeters long, forms with the horizon an angle of 8 to 10 degrees. Its extremity ends in a reservoir, C, in which also terminates the positive pole, *b*. The negative pole, *a*, is soldered into the tube, D. Behind A B there is a scale divided into millimeters. To prepare this instrument for use,

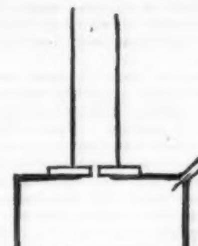


FIG. 1.

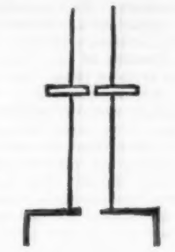


FIG. 2.

FIG. 3.

FIG. 4.

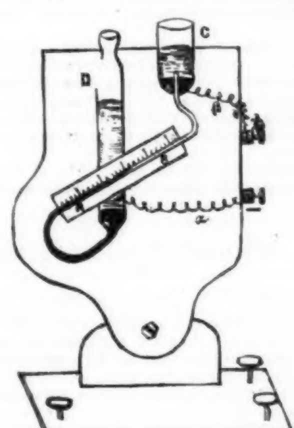


FIG 5

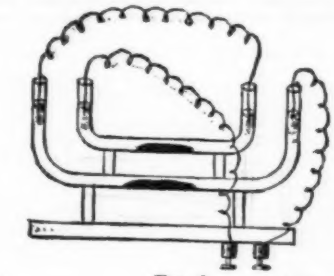


FIG. 6.

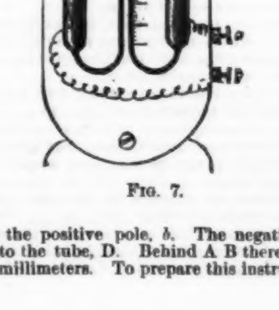


FIG. 7.

a and *b* are united; some acidulated water, and then a few drops of pure mercury, are put into the reservoir, C; enough mercury is poured into D to fill the tube, A, B, three quarters full; the air is expelled from the capillary tube; and, finally, a little acidulated water is added to D. By means of a joint the apparatus may be rendered more sensitive by inclining A, B. This electrometer can be graduated very easily.

M. Debrun has invented another apparatus which gives results very quickly. It is composed of two U-shaped tubes, each having a capillary branch (Fig. 6). These tubes are filled with mercury, and their capillary extremities dip into a common reservoir filled with acidulated water. While one of the menisci rises the other descends, thus doubling the deviation. The amount, and even the direction, of the deviation may change when the mercury is not absolutely pure. Suppose, for instance, that one tube (Fig. 7) contains a globule of pure mercury, and the other a globule of mercury containing a little zinc; it is found that when the current traverses these tubes in the same direction, the two globules move in opposite directions. The greatest deviation is obtained with water acidulated with about one-tenth part of pure sulphuric acid.

ON SOME POINTS CONNECTED WITH TERRESTRIAL MAGNETISM.

I have on more than one previous occasion brought forward some of the various points which are here grouped together. These points are three in number.

(*a*) Regarding the sustaining power of the earth's magnetism.

(*b*) Regarding the diurnal and other changes of the same.

(*c*) Regarding earth currents and auroras.

I may state at once that this only professes to be a working hypothesis.

(*a*) *Regarding the Sustaining Power of the Earth's Magnetism.*—I do not here intend to discuss the cause of the earth's magnetism, but I would ask in the first place if it is not possible that this cause may be something small and one which (assuming it to continue at the present moment) we may not readily perceive. If we assume this cause or magnetic nucleus to be small is it not possible to imagine that there is a machinery which acts upon this nucleus (just as we have in certain magneto-electric engines) so as to swell up the magnetism of the earth ultimately to saturation.*

May not this machinery be the great convection currents, the anti-trades, that go from the equator to the poles in the upper regions of the earth's atmosphere, and which may be looked on as conductors moving across lines of magnetic force?

It would appear to me that the tendency of such currents will be to swell up and sustain the magnetism of the earth.

(*b*) *Regarding the Diurnal and other Changes of Terrestrial Magnetism.*—It will, of course, be natural, entertaining the views now enunciated, to regard the diurnal changes of the convection currents of the earth's atmosphere, as these are manifested in the upper regions, to be the cause of the diurnal changes of terrestrial magnetism.

If this view be taken it might be argued that wind changes in these upper regions should also produce magnetic variations. The reply is, that apparently they do. In conjunction with Mr. Morisabro Hiraoka I have compared together the simultaneous records of magnetic declination ranges at Kew and at Trevandrum, and I find evidence of a progress of things from west to east, so that on the whole a particular magnetic-range phenomenon occurs at Kew 9·7 days before it occurs at Trevandrum. Again, I have attempted to show, in conjunction with Mr. Dodgson, that a particular magnetic phenomenon occurs at Kew one day before it occurs at Prague.

It would thus appear that there is a progress of magnetic phenomena from west to east, just as we know there is a progress of meteorological phenomena. As, however, the meteorological phenomena which we can examine occur in the *lower* atmospheric regions, while the magnetic phenomena are, according to this hypothesis, associated with currents in the *higher* regions, it does not follow that magnetic and meteorological phenomena should travel from west to east at the same rate. I may also mention that we have reason to believe that magnetic changes lag behind corresponding solar changes just as meteorological changes would do.

It is manifest that it will be comparatively easy to settle the fact of a progress from west to east of magnetic weather, and that if such exists it will most readily ally itself with the hypothesis above mentioned.

In the next place, if we regard those changes in the convection currents of the earth which depend on the year, we have reason to imagine that such are most pronounced at the equinoxes. It is also well known that magnetic disturbances are most frequent at these times.

Let us next proceed to regard the secular change of the earth's magnetism. To account for this magneticians have felt the need of something movable, and the hypothesis of a "little earth," a solid nucleus moving within the recesses of our planet, has found much support. But is it not more likely that the result may be caused by a secular variation in the distribution of the convection-currents of the earth? If the question be asked, What reason have we for imagining the existence of such a variation, the answer will be, A much better reason than we have for entertaining the conception of a "little earth." For there is some reason, at any rate, for imagining the power of the sun to be subject to a complicated series of periodicities. Now a secular variation in the power of the sun would produce a secular change not only in the intensity, but in the direction of the convection-currents of the earth, and, according to the above hypothesis, these in their turn would produce a secular magnetic change.

(*c*) *Regarding Earth Currents and Auroras.*—I have for some considerable time looked on the earth as a Ruhmkorff's coil with a magnetic nucleus. Above this nucleus we may suppose that we have the primary rocks, which are non-conductors, while above these we have the moist or comparatively moist surface of the earth, which is a conductor. Above this, again, we have the lower strata of the atmosphere, which are non-conductors, while above this we have the upper strata, which are conductors.

Now suppose that a small but abrupt change of the earth's magnetism takes place, no matter how. We need not enter into the causes of such.

We have thus two secondary coils, if I may use the expression: (1) the moist surface of the earth; (2) the upper regions of the atmosphere; and both of these will be animated with secondary currents, on account of the abrupt change of the earth's magnetism. These secondary currents will be in one direction for a magnetic change of one kind, and in the opposite direction for a magnetic change of the opposite kind.

Now, whenever there are magnetic storms, that is to say, when there are small but abrupt changes of the earth's magnetism, it is well known from the Greenwich records, that we have violent earth currents, which are alternately positive and negative, and that we have also auroral displays in the upper regions of the earth's atmosphere. We cannot examine the auroral displays as we can the earth currents. But with regard to earth currents I would remark that the *form* of the phenomena they display is entirely against the supposition that such currents are the main cause of the changes in terrestrial magnetism, and in favor of that which maintains that they are secondary currents induced by magnetic changes.

In conclusion, I would guard against its being supposed that all luminous appearances in the atmosphere are due to the same cause. I only hold that certain appearances which occur at times of magnetic perturbation and simultaneously throughout a large portion of the earth have the origin now mentioned.—*B. Stewart, in Nature.*

* If I am not mistaken Sir W. Thomson is inclined to regard the earth as a magneto-electric engine.

"TONGA"—A REMEDY FOR NEURALGIA.

Under the name of "tonga" a new remedy for neuralgia has recently attracted considerable attention among the medical profession. Tonga was introduced to this country from Fiji, some months since, with the account that "it has been used some years by the aborigines of the Fiji Islands, and a European, who married a chief's daughter, learned the secret from his father-in-law, in whose family the knowledge of the composition of this remedy had been an heirloom for upwards of 200 years." The peculiarity of the new drug is the rapidity of action on the nerves, which it is credited to possess, and the singular manner or form in which it has been brought to this country, namely, in small broken fragments consisting of a mixture of woody fiber, bark, and leaves, broken up into such small pieces as to make it almost impossible to identify any portion botanically. This broken vegetable matter is tied up into spherical bundles, each about the size of an orange. The wrapper of these bundles consists of the fibrous sheathing base of the leaves of the cocoanut palm (*Cocos nucifera*).

The mode of preparing a draught of tonga for use is extremely simple. The bundle, while still closed, is to be allowed to soak in cold water for ten minutes. The liquid is then to be squeezed out into a tumbler, and a claret glass of the infusion taken three times a day, about half an hour before each meal. The bundle is to be dried and hung up in a dry place, and can be used over and over again for a year. This peculiar substance has been tried in this country by medical men, and very successfully reported upon, effecting a cure, it is said, in the second or third day. Notwithstanding the broken state of this drug, as it has appeared in this country, Mr. E. M. Holmes, the curator of the Museum of the Pharmaceutical Society, has, after careful examination, arrived at the conclusion that the principal component part of the contents of the bags to be the stem of an arvideous plant, a species of *Rhaphidophora*, probably *R. vitiensis*.

HEADACHE AND EXERTION OF THE EXHAUSTED BRAIN.

Dr. Treichler, of Germany, says, in the *Medical Press and Circular:*

According to my experience, habitual headache has considerably increased with boys and girls. It destroys much of the happiness and cheerfulness of life, produces anæmia and want of intellectual tone, and, what is worse, it reduces many a highly gifted and poetic soul to the level of a discontented drudge. Although it is more difficult to collect precise statistical data on habitual headache than on myopia, yet the result of various investigations at Darmstadt, Paris, and Neuenberg, goes to prove that one-third of the pupils suffer from it. Undoubtedly the principal cause is intellectual over-exertion, entailing work at night, and the insisting by parents on the too earnest taking up of a variety of subjects—music among the rest.

The pathological anatomical changes in the worst cases of this unhealthy condition I consider to be a disturbance created by anæmia in the nutrition of the ganglion cells of the cortex of the cerebrum. It is well known that a badly-nourished brain is much more quickly fatigued by intellectual exertion than a brain in normal condition, just as is the case with the muscles.

A second cause of habitual headache is a passive dilatation of the blood vessels of the brain, also connected with serious disturbances of nutrition, whereby the perivascular space around the capillary vessels is contracted, and the getting rid of used-up matter greatly impeded. Modern pathology now looks on progressive paralysis in its earliest stage as a vasomotor disturbance of nutrition of the cortex of the cerebrum, in which the vessels of the pia-mater get into a palsied condition of dilatation, and we have degeneration of the cortex of the brain produced by stagnation of the current of lymph.

When the ganglionic cells begin to be diseased by senile atrophy the memories and scientific problems of youth are still clear, and can be reproduced, while the same ganglionic cells can no longer comprehend and work at new though much simpler scientific problems, and while, with regard to a thing of yesterday, the memory is uncertain. From this we may draw the following conclusions:

1. That what the ganglion cells when in their full health and vigor have grasped remains; so that, after the lapse of half a century, and, with the beginning of disease, it may still be reproduced.

2. That the ganglion cells diseased by old age are, in reference to the accomplishment of work, like greatly-exhausted ones, and have lost the power of understanding and abidingly taking in new and difficult ideas. The ganglion cells, therefore, can only take in new ideas, as an intellectual acquisition, so long as they are powerful, are not exhausted, and are nourished with healthy blood. The boundary line is drawn here quite as exactly as is the quantum of nourishment for the stomach of an invalid.

3. That the constant addition of fresh subjects in the teaching programme, making night work necessary for the pupil when the ganglion cells are already exhausted, entirely defeats its object of enriching the intellect, because new ideas cannot then be really grasped, and confusion is produced as to what has been learned in the day. The great object of the school, therefore—earnest intellectual discipline and the formation of the desire for continuous cultivation of the mind—is thereby frustrated.

REMEDY FOR DYSPEPSIA, CONSTIPATION, SICK HEADACHE, ETC.

Extract of hyoscyamus	2 drachms.
Extract of butternut	14 "
Oil of sassafras	1 "
Super. carb. soda	½ ounce.
Simple sirup	1 pint. Mix.

Dose: a teaspoonful or two just after each meal. If this should not prove sufficient to keep up regular actions from the bowels an additional tablespoonful at bedtime.

This prescription will be found to answer a most valuable purpose in very many cases of dyspepsia, as it fulfills almost every indication which we ordinarily have to meet in the management of the disease, viz.: allays nervous excitement, eases pain, and procures rest; neutralizes acidity, improves the tones of the stomach and bowels; excites the liver, and keeps up a regular and natural motion of the bowels. Excellent for sick headache.—*L. H. Washington, M.D., St. Louis Eclectic Med. Journal.*

AN IMPROVED SURGICAL NEEDLE.

Prof. von Bruns, of Tubingen, has altered his surgical needle so as to do away with the two objections to his old model, viz., the tendency to catch in the skin while withdrawing it, and the difficulty of cleansing the tube. The needle, as now manufactured, consists of a thin walled steel tube, 1½ mm. thick and 7 cms long, which terminates at one end in a solid, lance-shaped point; the other end is embedded in a wooden handle. A thin steel wire runs through the tube, ending toward the point of the needle in a small hook, and attached at the other end to a button which works in a slit in the handle. When the needle is passed through the flesh, the button is pressed forward, and the hook end of the wire projects through a small opening just below the lance-shaped head of the needle. The thread to be used is then passed over the hook and drawn with it back into the tube, and the needle is then drawn out, carrying the thread with it. The tube can be readily cleansed by drawing through it, by means of the same hook, a thread of thick, soft worsted, which can be moistened with any desired lubricant.—*Centralblatt fur Chirurgie.*

CHEMICAL SOCIETY, LONDON.

Thursday, June 3, 1880.

Prof. H. E. Roscoe, President, in the Chair.

Mr. W. H. Perkin read a paper "*On some Products of the Oxidation of Para-toluydin.*" In a previous paper on mauvein (*Journ. Chem. Soc.*, 1879, 728) the author briefly referred to some experiments on the oxidation of para-toluydin by chromic acid: the present paper continues the study of this reaction. A solution of the sulphate of para-toluydin was mixed with a solution of potassic dichromate. After twenty-four hours a large quantity of a brown precipitate formed. This was collected, washed, dried, and extracted with benzene. The benzene was colored a rich orange-red, and on evaporation furnished a red crystalline product. After a great deal of trouble and many re-crystallizations this was separated into two new bases, one less soluble than the other. The least soluble gave on analysis numbers indicating the formula C_7H_7N. Its crystalline form has been described and figured by Mr. L. Fletcher. The substance melts at 216° to 220°: it crystallizes in beautiful rhombohedral garnet-red crystals from benzol and ether. It readily dissolves in alcohol acidified with hydrochloric acid, forming a brownish red solution, changing to a red purple. With concentrated sulphuric acid this substance forms a magnificent blue color. A platinum salt was formed, indicating as the formula for this substance $C_{21}H_{21}N_3$. It is designated by the author tri-para-tolylene-triamine. The more soluble base was also obtained pure after much trouble. Analyses indicated the formula $C_{28}H_{27}N_3$. It may be derived from the preceding substance by replacing one atom of hydrogen by tolyl, and is therefore designated tolyl-tri-para-tolylene-triamine. It melts at about 175° C., and dissolves in alcohol acidified with acetic acid with a purple color; it separates from its ethereal solution in small, flat, prismatic crystals; it is an organic base, forming easily decomposable salts. In concentrated sulphuric acid it dissolves with a gray violet color, quickly changing to a pale yellowish green. A platinum salt was prepared and analyzed. No special advantage was obtained by substituting acetic for sulphuric acid in the oxidation process. By using a solution of para-toluydin in glacial acetic acid and a solution of chromic acid in the same solvent a different reaction was obtained. Golden-yellow needles were deposited, which, when purified, proved to be parazo-toluen; it fused at 143°.

Dr. Dupré then read a paper "*On the Detection of Foreign Coloring Matters in Wine.*" In January, 1876, the author proved that the true coloring-matter of wine dialyzed very slowly (*Analyst*, 2, 26, and 11, 186), and that the various coloring matters, said to be used in adulterating wine, dialyzed freely; also that small cubes of jelly, ¾" in the side, cut from a plate of jelly with a wet knife, could be used with great advantage in the analysis, as follows: Such a cube immersed for a definite period in the wine is taken out, washed with a little water, and a central slice cut out. If the wine is pure it will be found that in 24 to 48 hours the color has penetrated but a very little way into the cube, whereas many coloring matters will have reached the center. Since then the author has extended his researches, and the present paper gives an account of experiments with many coloring matters, made as above described. The results confirm those already obtained. The coloring matter of pure wine dialyzes very slowly. The only artificial coloring matter tried which does not dialyze quickly is that of alkanet root. Althæa, beet, bilberry, Brazil wood, carnation, cherry (red and black), clematis (purple), cochineal, cranberry, currant (red and black), elderberry, indigo, litmus, logwood, mallow, raspberry, red cabbage, red poppy, rhatany root, rosanilin, saffron and strawberry, all dialyze, and penetrate rapidly into the jelly. Alkanet can be readily distinguished from the coloring matter of wine by giving an absorption spectrum of three bands in acid solution. Ammonia changes wine coloring matter to greenish brown, which gives one indistinct absorption-band in the yellow. Alkanet is turned blue, and gives two absorption-bands. The nature of the coloring-matter can often be detected by the color of the gelatin cube, *e. g.*, indigo, logwood, etc.; if not, it is best to dialyze the wine through parchment-paper, and then apply the tests suggested by Gautier and others to the dialysate. The cubes of jelly are cut from a jelly containing 10 per cent. of dry gelatin, to which it is preferable to add 10 per cent. of glycerin.

The President asked if Dr. Dupré could account for the

non-diffusibility of the coloring matter: whether it was of an albuminous nature?

Dr. FRANKLAND suggested that the coloring matter might be in suspension: that it did not subside was no evidence against this view, as gold had been obtained by Faraday in a state of suspension so fine that it did not settle after many years' standing.

Prof. EMERSON REYNOLDS asked if the age of the wine did not alter the dialyzing power of the coloring matter.

Mr. PAGE suggested, as a substitute for the sheets of paper stretched on hoops, usually employed in dialysis, tubes made of parchment-paper, which could be obtained of almost any length, and were very convenient, as no joint had to be made. They can be obtained of Karl Brandegger, Ellwangen, Würtemberg, at four to five shillings per hundred meters.

Dr. DUPRÉ, in reply, did not think that the coloring matter was albuminous, but that it resembled somewhat a tannin. In his opinion the coloring matter was not in suspension, in proof of which it did not color the must until sufficient alcohol had formed to bring it into solution. He had examined 1834 Port and two-year old Port without detecting any difference in the dialyzing power of the coloring matter.

The two following papers were read by Dr. FRANKLAND: "*On the Action of Organo-zinc Compounds upon Nitriles and their Analogues.*" I. "*Action of Zinc-ethyl on Azobenzene,*" by E. FRANKLAND and D. A. LOUIS. When azo-benzene is added to an ethereal solution of zinc-ethyl, and the mixture warmed to the boiling-point of the ether, a reaction commences, accompanied with the evolution of much gas. As soon as it ceases it can be continued by adding a fresh quantity of azo-benzene, and so on until the reaction becomes sluggish, care being taken to employ an excess of zinc-ethyl. An amber colored jelly was thus obtained: it was decomposed by water, much gas being evolved; a reddish brown oil separated out with the zincic hydrate. By treatment with caustic soda the zincic hydrate was removed. The oil thus obtained was purified, and proved by analysis, etc., to consist mainly of aniline. The gas evolved during the reaction consisted of 3 vols. of ethylene and 1 vol. of ethylic hydride. From 80 grms. of azo-benzene 70 grms. of aniline were obtained. Besides the aniline, a small quantity of a high boiling point viscid oil was obtained, the investigation of which is not yet complete.

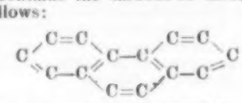
II. "*On the Action of Zinc-ethyl upon Benzo-nitrile,*" by E. FRANKLAND and J. CASTELL EVANS. Equal volumes of zinc-ethyl and benzo-nitrile were heated in a sealed tube to 150°. On cooling the contents solidified to a brownish mass. After treatment with alcohol and hydrochloric acid, white needles remained, sparingly soluble in alcohol, but dissolving readily in carbon disulphide, fusing at 229°. By analysis, etc., this substance was proved to be cyaphenine, $C_{21}H_{15}N_3$. The above reaction also takes place under ordinary pressure. On heating cyaphenine with concentrated hydrochloric acid in a sealed tube to 250° it can be converted entirely into benzoic acid and ammonia. The liquid obtained by treating the product of the zinc-ethyl reaction (after decomposition by alcohol) with hydrochloric acid deposited, on standing, faintly greenish six-sided plates. These, after purification, gave numbers indicating the formula $C_{17}H_{21}N_2Cl$. A further investigation of this hydrochlorate, which fuses at 257°, is promised. The gas evolved during the action of zinc-ethyl on benzo-nitrile consisted of equal volumes of C_2H_4 and C_2H_6.

Dr. ARMSTRONG suggested that it would be better to get rid of such terms as ethylic hydride. The researches of Dale and Schorlemmer had proved that there was no difference between ethane and ethylic hydride: moreover, the latter name suggested a distinction between one atom of hydrogen and the other atoms of that element which did not exist.

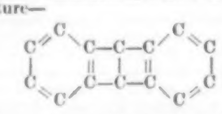
Dr. FRANKLAND quite agreed with Dr. Armstrong as to the desirability of abolishing the term if the identity of the two substances was fully proved; but, in his opinion, we should be very careful in abolishing an idea because it did not conform to the theories of the day. He quite admitted that Schorlemmer had proved the identity of a fraction of the products of the action of Cl on the two gases, but nothing had been done with the remainder of the products. He had waited for several years for any further investigation of the subject, and at last had determined to take up the question himself.

Dr. JAPP contended for the convenience of the term methylic hydride, irrespective of the question of isomerism, as in Butlerow's reaction.

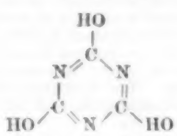
Prof. HARTLEY then read a communication "*On the Relation between the Molecular Structure of Carbon Compounds and their Absorption-spectra.*" In a previous paper, in which the author was associated with Prof. A. K. Huntington, it has been shown (1) that every increment of CH_2 in a homologous series of alcohols or of acids effects an absorption of the more refrangible of the ultra-violet rays, so that the greater the number of carbon atoms in the molecule the shorter is the transmitted spectrum; (2) that the terpenes always transmit continuous spectra, but polymerization largely increases their absorptive power; (3) that benzene and its derivatives invariably show, in addition to abnormally great absorptive power, the peculiarity of absorption-bands. After taking into consideration the numerous substances examined the conclusion seems inevitable that banded absorption-spectra were caused by the double linking of three pairs of carbon atoms in a compactly closed chain; and in the present paper the author has studied the effects of various atomic groupings on the absorption of ultra-violet rays. The first question was whether substances with two doubly-linked adjacent carbon atoms exhibit any peculiarities in their absorption-spectra. To decide this point, ethylene, amylene, and allyl alcohol were selected for examination, but in neither case were any absorption-bands seen. To ascertain the effect of the treble linking of two carbon atoms, the spectra of acetylene and valerylene were examined, but no absorption-bands were noticed. In all cases, therefore, where the carbon atoms are arranged in an open chain no absorption-bands are seen. In no carbon compound has any arrangement of the hydrogen or oxygen atoms been identified with the presence of absorption-bands. With hydrocarbons containing at least six atoms of carbon and their derivatives there are three possible arrangements which admit of the carbon atoms forming a closed chain: (1) Three pairs of carbon atoms may be doubly linked, as is assumed to be the case in benzene; (2) two pairs may be doubly linked; (3) the six atoms may be singly linked. There are reasons for believing that oil of turpentine and terebene have two pairs of carbon atoms doubly linked, and that a closed chain, including these two pairs of atoms, forms the nucleus of such substances. These bodies exhibit no absorption-bands, so the author concludes that a closed chain of carbon atoms, in which only two pairs are doubly linked, exhibits no absorption-bands. Now the constitutional formula of camphor is probably founded on a closed chain of carbon atoms. It is found to be very diactinic, more diactinic than the terpenes, so that probably its atoms are not so compactly united; this is consistent with a singly linked closed chain of carbon atoms. Camphoric acid similarly shows no absorption-bands. The author therefore concludes that no molecular arrangement of carbon atoms causes selective absorption unless three pairs are doubly linked together in a closed chain. The author next considers the absorption-spectra of condensed benzene nuclei. It was expected, from the generally accepted views as to the constitution of naphthalene and anthracene, that these substances would give a larger number of absorption-bands than benzene, and that the bands would be of greater intensity, *i. e.*, they would be capable of withstanding a great degree of dilution before they disappeared. The results obtained are rather remarkable; thus, a solution of naphthalene containing 1 in 60,000 shows four strongly-marked bands. Phenanthren contains the carbons of three benzene rings disposed as follows:



It shows three strong absorption-bands in a solution containing 1 in 4,000. Anthracene, which may be considered to have a structure—



was also examined. It was dissolved in glacial acetic acid. It has a considerable absorption when the dilution is carried as far as 1 in 50 millions. Pyridin gives an absorption-spectrum. Hydrocyanic acid is very diactinic. Cyanuric acid is not, and the author concludes that it has the formula—



Photographs of many of the spectra were exhibited.

The PRESIDENT congratulated Prof. Hartley on his interesting results; such work was of the greatest importance. The question as to the connection between structure and physical properties would probably form one of the most interesting chapters in the chemistry of the coming time.

Mr. GROVES asked if Prof. Hartley had investigated the effect of substitution in the side chains.

Prof. EMERSON REYNOLDS asked if the absorption-spectra were sufficiently definite to identify the various substances. The work seemed to him to be most important; it gave some air of reality to the three links and two links of which chemists now speak so frequently.

Dr. JAPP suggested the investigation of the class of trimolecular nitriles, so as to have compounds with a closed chain like the benzene ring.

Prof. HARTLEY, in reply, said that if the substances were pure it was perfectly easy to identify them, and the quantity of some substances, even in mixtures, could be roughly estimated.

"*On a Simple Method of Determining Vapor-densities in the Barometer Vacuum,*" by C. A. BELL and F. L. TEED. Notwithstanding the simplicity of the apparatus recently proposed by Meyer, many cases remain—*e. g.*, those of easily decomposable substances of high boiling-point, etc.—in which the older method of Hofmann would be preferable. Moreover most liquids volatilize in a vacuum at 100°, and this temperature can easily be maintained for any length of time. The authors have introduced two new devices: (1) By varying the external pressure, or otherwise the vapor is made to occupy a known volume; and (2) its pressure is directly determined by a single observation, which is independent of the atmospheric pressure. Thus the calculations are enormously simplified, and errors of observation are avoided. The simplest form of the apparatus consists of a glass cylinder, 34 cm. long and 3·3 cm. internal diameter, closed at its upper end. To its lower end is fused a stout glass tube, 8 mm. internal diameter, and 83 cm. long. 5 cm. below the junction with the cylinder a glass tube is fused in so as to form a T, and bent up so as to be parallel with the cylinder; it is sealed off a little below the upper end of the cylinder. The lower end of the long glass tube is closed by an India-rubber cork, through which passes a glass stopcock. The whole of the upper part of the apparatus is surrounded by a steam jacket. A fine line is etched on the glass tube about 1 cm. below its junction with the cylinder, and from a point on exactly the same level the side tube, which serves as a barometer, is graduatad upward in millimeters. The apparatus is filled with mercury, and after various precautions, the liquid introduced in a thin glass bulb, converted into vapor, and the pressure in the barometer tube observed, at which the vapor depresses the mercury to the mark etched on the tube. The volume of the cylinder being known the calculation is extremely simple.—*Chemical News.*

GASES IN ALUMINUM AND MAGNESIUM.

By M. DUMAS.

ON submitting aluminum in a vacuum to the action of a temperature gradually raised to the softening-point of porcelain, and causing the mercurial pump to act upon the retort containing the metal till it is completely exhausted, considerable quantities of gas are withdrawn. The liberation of the gas from the metal seems to take place suddenly towards a white-red heat. 200 grms. aluminum, occupying 80 c.c., gave 89·5 c.c. of gas at the temperature of 17°, and the pressure of 755 mm. The gas consisted of carbonic acid 1·5, and hydrogen 88 c.c. Carbonic oxide, nitrogen, and oxygen were absent. Magnesium, on similar treatment, gave off, weight for weight, double the volume of gas evolved by aluminum, 20 grs. of the metal giving 12·3 c.c. hydrogen and 4·1 c.c. carbonic oxide. Another specimen of magnesium evolved hydrogen 28·1 c.c., carbonic oxide 1·9 c.c., and carbonic acid 1·5 c.c. The magnesium which is volatilized in the retort crystallizes on condensing, and may serve for re-determining the atomic weight of the metal, which is open to some doubts. Further, the vapor-density of magnesium may be determined by volatilizing it in a vacuum. It appears, then, that hydrogen is occluded by magnesium and aluminum, as is oxygen by silver. It is possible that other gases may be selected by other metals.

PROTECTION AGAINST FORGERIES—PHOTOGRAPHIC AND OTHERWISE.

By JOHN SPILLER, F.C.S.

THE recent conviction of a notorious forger taken with his chemicals, tracing paper, and implements of trade around him, and the pending trials of other offenders, have awakened fresh attention to the means of combating these ingenious but misguided efforts; and perhaps it would be well now and then to take stock of our defenses, in order that the legitimate progress of science may not be allowed to leave in its track certain attendant disadvantages, helping the rogue at the expense of the honest trader.

With this object in view, I propose briefly to enumerate a few of the points which have come under my notice during the last twenty years, having reference to attempted forgery or tampering with bank notes, checks, and documents, questions upon which I have been frequently consulted by the printers. At one time it was an easy matter to clean off the obliterating stamps from an old postage head, and make it do duty a second time. This is no longer possible, since the principle of litho inks has been adopted, for now benzole will remove the Queen's head equally with the greasy ink stamped upon it.

To combat the removal of writing ink from checks and documents, Barclay proposed, many years ago, the use of a special kind of paper containing the ferrocyanide of manganese incorporated with the paper pulp, so that any unauthorized tampering with the original manuscript might be immediately revealed by the formation of Prussian blue, the iron being derived from the writing ink when attacked by acid. This project affords protection only up to the point of finding a solvent for the Prussian blue, which is not a very difficult matter.

In the year 1861 I was consulted as to the mode of production of a counterfeit bank note, which, allowed on all hands to have been a forgery, was supposed to be a spurious print from an engraved plate like the original. The rendering was in parts rather weak and defective, as though the note had been a faint and imperfect impression from the real plate. Shown to an eminent firm of engravers supposed to be well versed in such matters, they reported that "imitation had not been effected by photography." I was set to work to confirm or controvert this decision, and had to try and find out whether an engraver or a photographer was playing the rogue. My experiments led me to fix the responsibility on the latter, for I found that the whole design of the note was bleached by cyanide of potassium, and on burning some of the paper discovered both silver and gold in the ash. I reported the forged note to be "a gold-toned photographic impression," in opposition to the opinion of the aforesaid printers, who had actually produced the genuine notes for a foreign state. The minute details and highly finished vignette on the face of the note were all accurately copied; the paper was well imitated, and everything agreed with the original, except that a trifling deviation was found in the size of the note, or, rather, in the reproduction of its artistic design, as though by the careless use of the copying camera, or forgetfulness in allowing for the expansion of paper by wetting.

This circumstance, and other facts within my knowledge, prove conclusively that photographic forgeries have at times baffled detection, and it becomes therefore important to study the means of checking such attempts by resorting to the use of "colored overlays," and preventing, as far as possible, the taking of a photograph from one of the issued notes.

Lately an American discovery has been offering about in London, which professes, by the use of a non-actinic varnish, to render it impossible to copy a note by the camera.

But here, again, we must look to the guarantee of permanence, for what is to prevent the removal of the said varnish by a solvent, and its replacement by a "colorable imitation," when the work of copying is successfully accomplished? Quinine, according to the testimony of Dr. J. H. Gladstone, would serve in some cases, and tinting the paper is known to increase the difficulties; but I know for certain that one or two bankers are "leaning on a broken reed" in placing too much dependence on the supposed security of their bank notes against photographic counterfeit.

Colored overlays—by which we understand that certain parts of the note shall be printed over, and to some extent obscured, by the superposition of a colored design—are undoubtedly very effectual. Transparent, non-actinic colors are best adapted for this purpose; but then they must possess in a high degree the quality of chemical insolubility, or they might easily be removed, and the engraved plate pirated. Vermilion is one of the best, and Canadian green or Indian red are good; but Prussian blue, both from its phototransparency and easy solubility, is about one of the worst pigments that could be applied upon the face of a note. In my experiments it stood for naught, and I had no difficulty in copying the printed details on a note partially covered with an ornamental overlay in Prussian blue. Ultramarine is too opaque a color to use for overlays, but lends itself well in other ways to defeat the efforts of forgers; thus if an intricate design be printed on the face of a check where the amount and the signature have to be written in, any fraudulent attempt involving the use of acids will immediately make itself apparent by the irrevocable destruction of the fine design on those parts of the note. Mauve is a favorite ground of security, depending on the same principle, that of easy solubility, and hence it follows that manuscript documents are more secure if written on ultramarine or blue wove papers than when executed on the ordinary white or cream-laid, which, under the attack of acids, cannot show any appreciable change of color.

Of course it follows that a wide range of tints may be got by modifying the fundamental pigment by admixture with almost any one of the well-known artificial coloring matters, all of which are more or less affected, if not destroyed, by contact with acid.

NEW REACTION WITH GUM.

By C. REICHEL.

THE carbo-hydrates yield colored compounds with phenols in presence of acids. If gum and orcin are boiled for a time in concentrated hydrochloric acid a red coloration appears, which passes into violet, and a blue coloring matter is ultimately deposited. On the addition of alcohol a greenish blue solution is produced, which, on the addition of alkalies, turns violet with a green fluorescence. Similar is the behavior of cherry gum and bassorin, while dextrin, starch, cellulose, grape sugar, cane sugar, and milk sugar, if similarly treated, yield yellow or brownish colorations, which dissolve in alcohol with a yellow or orange color. Their alkaline solutions have a greenish fluorescence.—*Ber. Oest. Ges. Förd. Chem. Industrie.*

CHEMICAL STABILITY OF MATTER IN SONOROUS VIBRATION.*

A MULTITUDE of chemical transformations are attributed at the present day to the energy of ethereal matter, animated by those vibratory motions which produce calorific, luminous, and electrical phenomena. This energy, when communicated to ponderable matter, gives rise therein to decompositions and combinations.

Is it the same with the ordinary vibrations of ponderable matter—I mean with those sonorous vibrations which are transmitted by virtue of the laws of acoustics? The question is a very interesting one, and has a special bearing on the study of explosive materials, in which I have been interested for the last ten years. Ingenious experiments have been published in regard to this by Messrs. Noble and Abel, as well as by MM. Champion and Pellet, and many scientists admit that explosive bodies may detonate under the influence of certain musical notes, which cause them to vibrate in unison. However seducing this theory may be, the results which have been obtained do not incontestably establish it. The explosions by influence of dynamite and gun-cotton are more simply explained by the direct effect of the shock propagated by gases to short distance—beyond which they are not propagated. As for iodide of nitrogen, which is the subject of the principal observations relative to explosions through resonance, it is a powder so sensitive to friction that it is permissible to ask whether its detonation does not take place through the shocks and frictions of the supporting objects—the true seat of the resonance in unison.

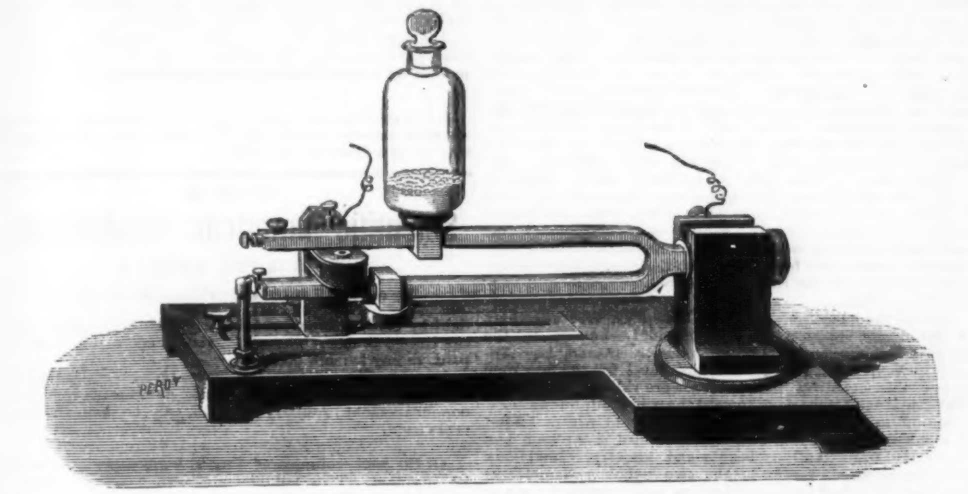


FIG. 1.—M. BERTHELOT'S APPARATUS FOR THE STUDY OF THE INFLUENCE OF VIBRATIONS ON CHEMICAL PHENOMENA.

It has seemed to me that it would be of utility to undertake some new investigations on gases and liquids, which are substances better fitted than a powder for the propagation of a vibratory motion, properly so called. I chose, moreover, substances that were decomposable with a liberation of heat, so as to reduce the *role* of the vibratory motion in producing a reaction without obliging it to perform the total work by virtue of its own energy. Finally, I operated on unstable bodies, and even on those in a state of continuous decomposition, which it was only a question of accelerating. These, I believe, are the most favorable conditions. The whole question was to make the substance resound into a chemical transformation. I succeed in this by two processes, which afforded vibrations of very different rapidity, namely:

(1.) By means of a large horizontal tuning-fork set in vibration by an electrical interrupter, and one of the arms of which was loaded with a flask of 250 cubic centimeters containing the gas or the liquid, and the other arm with an equivalent mass. The effective vibration of the flask was verified, as well as that of the liquid, which was made manifest, moreover, by the usual optical appearances. This process gave about 100 simple vibrations per second. (Fig. 1.)

FIG. 2.—SECOND APPARATUS OF M. BERTHELOT FOR THE SAME PURPOSE.

(2.) By means of a large horizontal glass tube, sealed at both ends, gauging nearly 400 cubic centimeters, and being 60 centimeters long by 3 centimeters in diameter, and, finally, set in longitudinal vibration by the friction of a horizontal wheel covered with damp felt. This exceedingly simple apparatus, which was obligingly arranged for me by M. Koenig, made, according to comparisons by this learned constructor, 7,200 simple vibrations per second in my experiments on ozone. (Fig. 2.) The sharpness of this note is almost intolerable. The following are the results observed on ozone, arseniureted hydrogen, sulphuric acid in presence of ethylene, oxygenated water, and persulphuric acid:

Ozone.—The oxygen employed contained proportions of ozone, such as 58 milligrammes per liter—a sufficient quantity to be easily made sure of by my apparatus. With the tuning-fork (100 vibrations), the vibratory state having been kept up for an hour and a half, the character of the gas as to ozone remained constant, as well with dry ozone as with ozone placed in the presence of 10 cubic centimeters of water. The latter neither decreased the proportion of ozone nor furnished any oxygenated water.*

With the tube and wheel (7,200 vibrations), the vibratory state having been kept up for half an hour, the character of the dry gas did not vary. To be precise, I will say that the absorption of the ozone having been effected afterward by arsenious acid, the diminution of the proportion was found to be equivalent to 171 divisions of permanganate; while this diminution was exactly 171 in an equal volume of the same gas analyzed before the experiment. Ozone is a gas which is transformable into ordinary oxygen, with an evolution of heat (—14·8 cal. for Oz.=24 grammes). Its transformation took place spontaneously, and in a slow and continuous manner, so that it passed from 53 to 29 milligrammes in twenty-four hours, when it was left to itself under the above conditions. Still, as may be seen, its transformation was not hastened by a motion which caused it to vibrate 7,200 times per second for half an hour. Its spontaneous decomposition, then, could not be attributed to those sonorous vibrations which are incessantly traversing all bodies in nature. Such an absence of reaction is not explainable, moreover, by an opposite influence; for a similar tube filled with pure oxygen did not, by a single division, modify the character of the arsenious solution, after vibrating in the same manner and for the same length of time.

Arseniureted Hydrogen.—An analogous vibratory motion communicated to a tube filled with this gas and then sealed did not change it. Within the space of twenty four hours, however, the tube began to be covered with a coating of metallic arsenic, just as does a tube filled with the same gas and submitted to no vibration. This gas, when separating into its elements, liberates, according to M. Ogier, +36·7 cal., and this explains its instability; as may be seen, it is not increased by sonorous vibrations.

Ethylene and Sulphuric Acid.—I have endeavored to hasten the slow combination of these two bodies by vibratory motion, a thing so easy of performance under the influence of continuous agitation and with the aid of shocks produced by a mass of mercury. It is, however, exothermic. A flask of 240 cubic centimeters containing pure ethylene, with 5 to 6 centimeters of sulphuric acid and mercury, was put in vibration by means of a tuning fork (100 vibrations per second); the acid vibrated and became pulverized on the surface. Yet, at the end of half an hour the absorption of the gas was small, and about the same as in a like flask which was at rest in a distant room. Let me here add some experiments as to the influence of compression upon the same system. This influence, which was so efficacious on a mixture of phosphureted hydrogen and hydrochloric gas in M. Ogier's experiment, had little perceptible effect on ethylene compressed as far as 80 atmospheres and liquefied by contact with monohydrated sulphuric acid for a few minutes. It was thus possible to compress oxide of carbon up to 400 atmospheres, and keep it in contact with concentrated solutions of potassa (in water and alcohol) for a quarter of an hour without any perceptible absorption taking place. It is probable, however, that these reactions would be hastened if the compression should be prolonged for several hours. But let us return to the influence of vibratory motion on chemical decomposition.

Oxygenated Water.—Ten cubic centimeters of a solution containing 9·3 milligrammes of acetic oxygen, put into a flask of 250 cubic centimeters, did not change character through the effects of the motion of the tuning fork (100 vibrations per second) maintained for half an hour. Yet the liquid really vibrated and lost at that moment 0·9 milligramme of oxygen per twenty-four hours. Ten cubic centimeters of a solution containing 6·3 millimeters of active oxygen, set in vibration (7,200 per second) in a tube of 400 cubic centimeters full of air, for half an hour, afterwards furnished 6·25 milligrammes.

Persulphuric Acid.—The same results. With the tuning fork (100 vibrations), initial character 13 milligrammes; final character 12·8 milligrammes. The difference here seems to be a little in excess of the speed of spontaneous decomposition, and which is greater, however, than in the case of oxygenated water; but it scarcely exceeds the limits of error.

The results observed with regard to there liquids merit the more attention from the fact that such systems might possibly be likened, *a priori*, to liquids which retain oxygen in a state of supersaturated solution—a solution which is brought back to its normal state by agitation, and especially by vibratory motion. In fact the foregoing liquids do indeed contain some little proportion of oxygen in this state, as we may easily assure ourselves; but this portion of oxygen acts neither on the permanganate nor on the iodide of potassium employed in the mixtures, and should be considered apart. Really, it does not intervene here in any equilibrium of dissociation that is capable of being influenced by the separation of the oxygen from the oxygenated water. Doubtless it would be otherwise in a system in a state of dissociation, and the equilibrium of which was kept up by the presence of a gas actually dissolved; but then it would be no longer a question of the direct influence of vibratory motion on chemical transformation. Experiments made upon gases are not subject to this complication; and they tend to dispel the hypothesis of a direct influence of the sonorous vibrations (even very rapid) of gaseous particles on their chemical transformation. In other words, matter is stable under the influence of sonorous vibrations, while it becomes transformed under that of ethereal vibrations. This diversity in the mode of action of the two classes of vibrations ought not to surprise us when we consider that the sharpest sonorous vibrations are incomparably slower than luminous or calorific ones.

* M. Berthelot, in *La Nature.*

* In these experiments it is well to guard against the alkalinity of the glass, which would rapidly destroy the ozone. Such an accident is especially liable to occur with powdered glass.

PREPARATION OF MALONIC ACID.

By E. BOURGOIN.

THE author dissolves 100 grammes monochloracetic acid in double its weight of water, and saturates the solution with potassium bicarbonate about 110 grammes. He adds then 75 grammes pure potassium cyanide, and, after dissolving, heats carefully in the water bath. To the liquid are added two volumes concentrated hydrochloric acid; the deposit of potassium chloride is removed, and the liquid is supersaturated with gaseous hydrochloric acid. The salts deposited are strained off through a plug of asbestos, and the mother liquor which they hold back is displaced by a little hydrochloric acid. The washings are added to the acid solution, which is evaporated at first at a boil and then on the water bath. The residue, almost dry, is exhausted with ether, from which pure malonic acid is obtained on distillation or evaporation.

THE FROG-POISON OF THE NATIVES OF COLOMBIA.

WHILE the botanist and traveler, Ed. André, was at Cartágo (State of Popayan), during 1876, for the purpose of collecting living orchidaceous plants for Europe, he met at the Rio de la Viéja an old negro, Pedro, the same who had previously accompanied the explorers Gustav Wallis and Roezl, and whose services he also engaged. One day, he brought him a frog, which he said he had caught at great risk to himself. It was a small, lank animal, of lemon-yellow color above, with black legs and abdomen, which is met with in the *tierra templada* at an elevation 1,500 to 2,000 meters above the level of the sea. In the province of Chocó, it is called *neará*, and is feared as a most poisonous animal, for which reason the Indian tribes of the Cunas, Noanamas, and Chocóes, which inhabit the immense virgin forests of Chocó, use the poison of this frog, in place of urari, for killing game. This is done by means of arrows shot from a blowing-tube (*bodoquera*), of about three meters in length, which is made from two halves of a palm-stem, wound about with fibers, tightened with a black gum. The arrows are made from young bamboo-shoots. The poisonous *neará* is obtained by the Chocóes in the district of the Rio Tatamá. (It has also been met with by the botanist Triana, in the forests of Tamana, on the road from Cartágo to Novita.) The Indians guard their hands by winding around them broad leaves, and after having caught the frog, inclose it into a piece of bamboo, and suspend by the hind legs over fire. This causes the frogs to exude an acrid-yellow liquid, into which the arrows are dipped. Bamboo-sticks having been put together over the fire, the frog is suspended from them, and the exuded poison is caught by a woman, who collects it by means of a sort of scraper or spatula, in a small earthen vessel (*ollita*), in which it gradually assumes the consistence of curare. The arrows are not dipped into the poison until the latter has solidified. In this condition the natives carry it about with them in their quivers. The effects of the poison are said to be precisely similar to those of curare, as it is innocuous when swallowed, but, if introduced into the blood, speedily causes a paralysis of the vital powers. It is said to require three to four minutes to kill a bird, two minutes to kill a deer, and four to eight minutes to kill a jaguar. An antidote is not known; if any of the natives happens to wound himself with one of the poisoned arrows, he at once lies down, knowing he will speedily die. André believes that a compression and interruption of circulation in the injured member and subsequent cauterization would probably be found effective antidotes.

The *neará* is a small frog of the genus Phyllobates, which has no palatal teeth, but a tongue attached in front and free behind. André considered it to be a variety of *Ph. bicolor*, of Cuba, which, however, lives upon trees, while the Colombian frog does not climb. A Colombian physician, A. Posada Arango, who has carefully studied the animal, proposes to make a new species of it, *Ph. Chocoensis*; but André prefers to name it *Ph. bicolor*, var. *toxicaria*. According to him, the frog is found in the shady virgin forests of Chocó, between Anserma Viéjo and Novita, also in the forests of Tatamá, about the sources of the Rio San Juan, and generally about 78–79° West. long. (fr. Paris) and 5° North lat.—*Die Natur.*

A BOTANIST IN SOUTHERN CALIFORNIA.

By Joseph F. James.

He who would see California at her best should come here in the spring. If the traveler arrives about the middle of March he will find the spring in all its beauty and freshness. After his passage over the snowy Sierra he will be delighted at the change from ice and snow to green grass and flowers; from cold and cutting northern winds to gentle balmy southern breezes. The sky will appear of a brighter blue and the grass of a greener tinge than he ever saw before, and he will feel a vigor and a freshness which he has not felt in many a long day. There seems to be a something in the air of California which makes it different from what it is elsewhere. It may be that it is possessed of more ozone than common, and the presence of that material freshens up one's thoughts and feelings. The rains of the winter season will then be over, and the grass and flowers will be seen in all their verdure and freshness. On the other hand, should he arrive in the summer, he will find everything dried and parched; and as first impressions are always the most lasting, it is likely that he will have a much poorer opinion of the country than if he had seen it first in all its beauty.

To a botanist, California is almost a paradise, and although he will not find in it much of that magnificent vegetation and those grand and interminable forests which are characteristic of tropics, we venture to say that he will find here as many, or nearly as many, curious and interesting forms of vegetable life as he can find in any other country of the world. The distribution of rain during the year has been the cause, at least in Southern California, of a peculiarity in the development of vegetable life. Rain falls only from November to March, and the remainder of the year is dry and hot. By the middle of June or July many of the plants and flowers have disappeared; the grass is dry and parched, and the whole country assumes an appearance which is extremely depressing. Most all the flowering plants appear, therefore, in the spring, and it is almost next to useless to hunt for them, except along the banks of streams and in deep shaded cañons, after the first of June.

But the spring! Ah! that is the time. It would be almost impossible to find a more beautiful sight than is then visible in the vicinity of Los Angeles, in the metropolis of Southern California. Then the plains surrounding that city, the hills, and the valleys are one mass of gorgeous brilliant flowers. They are there by thousands upon thousands, and of almost endless variety. We shall attempt to enumerate some of them, and give a general idea of the appearance of the country in its season of beauty.

Most conspicuous of all, both for its abundance and its color, is the California poppy (*Eschscholtzia californica*, Cham.) Never have I seen such a brilliant mass of color as was presented by this plant last spring. It covered acres of ground, and the bright golden yellow or orange of its flowers, conspicuous among the mass of other verdure, was visible for miles. I have one patch in my mind now which, seen on a bright clear day, was, with the sun shining full upon it, too dazzling for the eye to gaze upon. Truly it was the "Field of the Cloth of Gold." In places where the ground had been plowed paths of it had been left, and they seemed like tongues of fire running over the ground.

Two species of Alfillerilla, or pin clover (*Erodium cicutarium*, L'Heer, and *E. moschatum*, L'Heer), are very common. These are very valuable as forage plants, and without them it is hard to tell what the country would do. Both species are very similar, one having the leaves more finely dissected than the other. The flowers are small and of a bright purple. The seeds are peculiar. After the petals have fallen the pedicels become deflexed, but the seeds still stand upright. They are five in number, united to a stylus, and each one is furnished with an awn an inch or so in length, with hairs at the base. When the seeds ripen and dry they split the capsule at the base, and each one begins to twist on its own account; when they get through, the awns of all are closely twisted together, and the seeds stick out on all sides. If one seed is separated from the others before it is fully ripe, and examined, the awn will be seen to twist. It dries very rapidly, and in the contraction turns the seed round and round till a close coil about half its length is formed, and this coil sticks out at right angles from the seed. On wetting the awns again they will untwist and become as straight as before. This seems to me to be a provision of nature for forcing the seed into the ground. Be that as it may, the seed itself is very hard and sharp pointed, and has a faculty of sticking very close to anything it gets into.

The *Sidalcea malvæflora*, Gray, is one of the prettiest and commonest of the plants of the plains. It grows from one to two feet high, and has the large purple flowers interruptedly ranged on the stem, with the round cordate and crenate leaves at the base. *Platystemon californicus*, Benth., known as cream cups, is very common. The flowers are white or cream colored, and are raised on naked hairy peduncles four to six inches long, looking something like an anemone. *Dodecatheon meadia*, L. (var.?), the shooting star, common in the East, is occasionally seen, and, with its pretty and curiously shaped flowers, reminds one of the rocky banks and shady ravines where it finds its Eastern home. Several species of Orthocarpus, with small curious purple flowers, are common; one species (*O. purpurescens*, Benth.) is small and inconspicuous in itself, but it grows in dense masses, covering the ground for miles, and giving it a purplish hue. The *Bæria gracilis*, Gray, a small composite plant with bright yellow flowers, is so common as to cover acres of ground and add its quota to the general glory. *Sayia platyglossa*, Gray, is also common, its yellow flowers tipped with cream color. Occasionally a patch of *Pæonia brownii*, Dougl., greets the eye with its large dark purple or reddish flowers, and heavy, thick, bright-green leaves. The poor man's weather glass, or pimpernel (*Anagallis arvensis*, L.), with its bright pinkish flowers, is common in cultivated grounds. *Collinsia bicolor*, Benth., with bright purple flowers, hides itself modestly under greasewood bushes and sage brush. *Castilleia passiflora*, Bong., with its flaming scarlet flowers, looks, in the distance, like the *Lobelia cardinalis*, that beauty of the swamps and meadows of the East. *Penstemon cordifolius*, Benth., and *P. centranthifolius*, Benth., adorn the banks of streams with their scarlet flowers. In shady places the tall green *Scrophularia californica*, Cham., similar to *S. nodosa*, L., towers far above the low but pretty *Claytonia perfoliata*, Donn., with its raceme of white flowers. This last delights in damp, shady places, and in such localities it is very common. *Salvia carduacea*, Benth., is common in dry, sandy soil, as is also *S. columbariæ*, Benth., with its cluster of blue flowers. The *Amsinckia spectabilis*, Fisch and Meyer, a small, inconspicuous plant with yellow flowers, is so common as to cover acres of ground. Two species of Phacelia (*P. ramosissima*, Dougl., and *P. tanacetifolia*, Benth.), with white and blue flowers, are common, while their near relative, *Nemophila aurita*, Lindl., with pretty blue flowers, and weak in the stem, helps to raise itself above the ground by climbing with its prickly stem up other plants. *N. insignis*, Dougl., also with blue flowers, is very pretty and common, and is one of the earliest spring flowers.

The species of Gilia are very numerous, and many of them have such differently shaped flowers and such varied habits of growth that a novice would never place them in the same genus. There is the *G. californica*, Benth., which has large funnel-shaped purple flowers, and leaves awl-shaped and bristle-like, and grows into quite large bushes. As an opposite is the *G. intertexta*, Steud., a dwarf form of which has small white flowers, and forms a mat spread out close on the ground. Then the *G. multicaulis*, Benth., with its short upright stem and small bunch of purplish flowers, is very different from the *G. densifolia*, Benth., with a white wooly stem, linear-pointed leaves, and large bright blue flowers in dense clusters.

The *Convolvulus occidentalis*, Gray, with its large white flowers, twines over the ground and bushes. Though the Liliaceæ are not numerous in species, there is one, *Calochorus splendens*, which is very handsome. The flower is quite large, of a purple-blue color, raised on a long slender stem, and, as it waves to and fro in the air, it well merits its name of "splendens." *Datura meteloides*, D. C., common on the roadsides, quite puts to shame its relative, the "Jamestown weed," of the East. It has large white flowers, six and eight inches long, and forms a bush two or three feet high. It possesses none of that vile odor peculiar to the "Jamestown," but has rather an agreeable smell. *Mirabilis californica*, one of the Nyctaginaceæ, is common all over the hills, and has viscid, sticky leaves and stem, and bright purple silver-shaped flowers. *Euphorbia albomarginata* forms large mats on the ground, one plant sometimes covering very closely a space two feet in diameter. *Sisyrinchium bellum* takes the place of the Eastern *S. bermudiana*, which it very much resembles.

One of the handsomest plants I have ever seen anywhere is the *Yucca whipplei*, Torr., commonly known as the Spanish bayonet, and it is quite common around Los Angeles. Never shall I forget the sensation I felt the first time I saw this beautiful plant. We were riding up a cañon, near San Juan Capistrano, toward the warm sulphur springs, when off to our right appeared a tall mass of white. What it was we could not tell, but, riding toward it, we soon had it revealed to us in all its beauty and majesty. Imagine a stalk ten or fifteen feet in height, two inches in diameter at the base, branched like a candelabra, and covered for six or eight feet of its height with a mass of cream-colored, bell-shaped, drooping flowers. At the base the long, sharp, serrated leaves stuck out on all sides, as if to guard against the approach of any injurious animal. When seen standing along the mountain side, its white mass of blossoms outlined against the dark background of the naked rock, it looks like a sentinel keeping guard over the valley; and numbers of them ranged one after another, and one above another, looked like a troop of soldiers placed there to stand guard. They grow in such steep and inaccessible places oftentimes that it is impossible to get at them. As it gets old the leaves become frayed at the edges, and the fibers hang like long filaments down each side of the leaf.

Ranunculus californicus, Benth., is very common in wet and damp places, and *R. cymbalaria*, Pursh., grows in great profusion in the sand on the bank of the Los Angeles River. *Viola pedunculata*, Torr. and Gray, with its pretty yellow and black flowers, is conspicuous amid the flowers of the plains, and *Nasturtium officinale*, R. Br., almost blocks up the water of slow-flowing and shallow streams. It grows in shady places, sometimes three feet high, and in such dense masses as to make it difficult to force one's way through it. *Vitis californica*, Benth., the only representative of the Vitaceæ in California in a wild state, is common, and climbs high over the willow hedges and bushes in damp localities. The deadly *Rhus diversiloba*, Torr. and Gray, own cousin to *Rhus toxicodendron*, L., of the East, is too common all over the plains, hills, and cañons of Southern California, and while some persons can handle it with impunity, others barely touching it are afflicted with a severe cutaneous eruption. *Tellima cymbalaria*, Gray, is a very pretty little plant with radical leaves and a cluster of white flowers on the end of a long scape. It grows in damp, shady places, and is very common.

There are several genera which are very common all over California, and many of the species resemble each other so closely as to be nearly undistinguishable. Among the Leguminosæ, for instance, the genera Lupinus, Hosackia, and Astragalus are all large. The species of the last are very numerous, and so closely connected as to cause great trouble in separating them. Nearly all the species have white or yellow flowers, pinnate leaves, and bladdery pods. The rattle weed is one of them, and is so named because the dry pods swept over the ground by the wind make a noise like the rattlesnake's warning. Another is the Loco plant, a terror to owners of horses and cattle. It is said that when eaten by animals it acts like a slow poison. A horse, for instance, seems to be affected in the brain; he becomes stupid, easily frightened at any little object coming suddenly before him, is inclined to run away, and often goes mad, insane, and, to wind up all, dies from its effects. A locoed horse can easily be detected by the dull, stupid look in his eyes. Among the lupines there are some of our most gorgeous flowers. The shrubbery species often grow four and five feet in height. The *L. rivularis*, Dougl., has large bright green leaves and spikes of bright blue flowers, often two feet in length. As an antithesis to this there is the *L. micranthus*, Dougl., which is from four to eight inches high and has small white or bluish flowers. The *Hosackias* are sometimes bushes four to six feet high, and sometimes lie flat on the ground, the stems of a single plant being three to five feet long. The flowers are generally yellow and the leaves small and three-parted.

Along all the roads, and covering the ground otherwise devoid of vegetation, we see the mock orange (*Cucurbita perennis*, Gray); the flowers are quite large and yellow, leaves very rough and scabrous, and the fruit hard, round, and yellow, looking like an orange. The root extends into the ground three or four feet, and is sometimes as big round as a man's body. The *Megarrhiza californica*, Torr., another species of the Cucurbitaceæ, twines over the rocks and bushes in a luxuriant manner; it has long tendrils, which are slightly sensitive; when rubbed on one side they soon bend toward that side and twine round any support they may happen to touch. Along in July the *Clematis ligusticifolia*, Nutt., with its panicles of white flowers or carpels with long silky tails, climbs over shrubs and into trees along the water courses. *Brassica nigra*, Boiss., the common mustard, is one of the most pernicious weeds of the whole of Southern California, and it covers the ground in many places for acres to the entire exclusion of other plants. Sometimes it is eight and ten feet in height and two or three inches in diameter at the base. I have ridden through fields of it early in the spring when it was as high as the saddle on the horse. *Malva borealis*, Wallman, is another very troublesome weed, and grows everywhere round houses and in waste ground; in old sheep and cattle corrals it is especially luxuriant, and grows sometimes so thick and strong that even a horse has difficulty in forcing his way through it. It closely resembles *M. rotundifolia*, L.

Several genera of Onagraceæ are abundant in species and specimens, Œnothera and Godetia being the most abundant. A small plant belonging to this order, *Clarkia elegans*, Dougl., is found in shady cañons, and is remarkable for its queer-shaped, handsome, purple flowers, and is often cultivated. The *Zauschneria californica*, Presl., has bright red flowers, and adorns dry banks and hills in the summer. *Isomeris arborea*, Nutt., one of the Capparidaceæ, is a small shrub with yellow flowers and inflated pods, and is very common near San Diego, flowering in November. A species of Hydrocotyle is very common in slow-flowing streams, and its circular crenated leaves seem to float on the water, and among them are thousands of specimens of *Azolla americana*, covering the surface of the water with its green mantle for considerable spaces.—*American Naturalist.*

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